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LECTURES ON SURGERY

BY JAMES SPENCE, F.R.S.E.,

SURGEON TO THE QUEEN IN SCOTLAND; PROFESSOR OF SURGERY IN THE
UNIVERSITY OF EDINBURGH; LATE PRESIDENT OF THE ROYAL
COLLEGE OF SURGEONS, EDINBURGH; SURGEON TO THE ROYAL
INFIRMARY AND LOCK HOSPITAL; CONSULTING SURGEON
TO THE ROYAL HOSPITAL FOR SICK CHILDREN,
EDINBURGH, ETC. ETC.

PART III.

EDINBURGH

ADAM AND CHARLES BLACK

1871

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SPECIAL OPERATIONS.

LECTURE LXXIV.

Operations: necessary Precautions regarding them—Preparatory Examination and Treatment of Patient—Points of Detail in reference to collateral Arrangements—Use of Anæsthetics: Hints and Cautions with regard to their safe Administration—Plans for the Operations—Assistants—After-Treatment of Patient.

IN entering on the department of the course which includes the greater surgical operations, I think it right to bring before you, in a suggestive form, the consideration of certain points which require to be attended to, if we would obviate sources of danger and secure a successful result.

Dexterity, care, and precision in performing an operation are most important elements of success. But there are other conditions which, if neglected, may mar the success of the most dexterously-performed operation. The conditions I allude to may be embraced and briefly discussed under the following heads:—

1st, The preparation of the patient by suitable preliminary treatment. 2d, The arrangements for the operation. 3d, The use of anæsthetics. 4th, Certain general principles to be attended to in all operations. 5th, The after-treatment.

1. In former times the preparatory treatment of patients about to undergo operations was a very formidable matter. A system of “training” by medical treatment, diet, and regimen, was carried out with extreme care, and so prolonged that it often induced evils of a different kind, but quite as dangerous as those which it was intended to obviate; and hence, as is very often the case, this

extreme led to the opposite—the neglect or disuse of preliminary treatment. An operation, however slight or simple it may appear to the surgeon, must always be to the patient a source of great anxiety and distress. When, therefore, an operation is decided on, the less unnecessary delay and suspense the better, as the patient in the interval is liable to become nervous, depressed, and less fitted for the ordeal. Whilst, however, prolonged preparation is to be avoided, a certain period of delay is necessary in most cases of operation, except in those cases where it is required for the results of injury or other urgent causes. Thus, in the case of patients who are brought from a distance, or those admitted into hospital, it is advisable that some days should elapse before they are submitted to operation, not only that a period of rest may be afforded, but also that the surgeon may have an opportunity of carefully examining the state of the patient, and conducting the preparatory treatment accordingly. In all cases a careful examination of the chest should be made, and the state of the abdominal viscera should as far as possible be ascertained. The condition of the tongue, skin, pulse, alvine excretions, and urine, requires to be carefully attended to. If the skin be hot and dry, the tongue foul, and the secretions unhealthy or diminished, or if irritative fever be present, the operation should be delayed till these conditions have disappeared. Rapidity of pulse, and debility arising from hectic depending on the disease which requires the operation, form no reasons for delay, but rather indicate the necessity for the operation being performed to remove the cause of the hectic. In cases where the urine is albuminous, we should test it frequently, and at different periods of the day, to ascertain whether the condition is temporary or persistent, and delay operating until we have thoroughly investigated whether there be any extensive organic disease of the kidneys or not. When there is much lumbar pain, urine scanty, coagulable, and accompanied by cedema, the condition is a contra-indication to operation ; but by dry cupping and cataplasms over the lumbar region, and the use of diaphoretics, mild diluent drinks, and gentle purgatives, this

condition, if it depends on temporary congestion of the kidney, may yield to treatment, and then the operation may be performed with a reasonable hope of success. In cases of disease in which irritative fever or much suppuration has been long present, or in cases of malignant tumours, there is a great tendency to blood-contamination, and hence prophylactic measures to diminish the risk of pyæmia should be had recourse to before as well as after the operation. The prophylactic remedies in which I have most faith are preparations of iron and chlorate of potash in moderate or small doses, so that they may mix with the food and enter into the formation of the blood. If given in large doses, they simply irritate the bowels, and are rapidly carried off by the alvine and urinary secretions and excretions. In performing operations on females, we should studiously avoid the catamenial period, and if present wait till it has passed. The patient is generally more excitable and irritable during the menstrual period; and even in cases in which operations have been performed previously, an unfavourable change is often noticeable during that period, healthy action in the wound being restored as the discharge ceases. At the same time, whilst it is well to observe this precaution in ordinary cases, the presence of the catamenia should never be a bar to the performance of operations of urgency. Whilst I have thus instanced some of the conditions to be specially attended to; in a large proportion of cases, all that is required is to give the patient some gentle alterative or a mild purge a day or two previous to the operation, and to regulate his diet, so that the digestive organs may be in a favourable state.

2. ARRANGEMENTS FOR THE OPERATION.—In hospital practice, a theatre designed with a special view to the performance of operations, well lighted, and furnished with suitable tables, and all other appliances, together with the existence of an organised staff of medical assistants and nurses, render the arrangements for operations so methodical, simple, and apparently routine, that the requisite details and the forethought required in making the arrangements are scarcely noticeable to students who witness

operations. Hence I consider it more necessary to draw your attention to what forms a most important condition for the proper performance of an operation, and specially so in private practice, where everything must depend on the forethought and careful directions of the operator. In all cases of operation not arising in emergencies, it is desirable that the proper arrangements should be made beforehand, so that nothing be left to be done in the confusion and excited state in which a private family generally is on the day of the operation. As all the necessary requirements are simple and easily obtainable, the arrangements can be made without any parade or alarm to the patient, whilst much time and annoyance is thereby saved both to the family and the operator. If the bedroom of the patient be tolerably large and well-lighted, it is advisable that the operation be performed there, as appearing less formidable than transporting the patient into another room. In all great operations I consider it most essential that the patient be placed upon a table to undergo the operation. This enables the operator and his assistants to act more easily in concert, to obtain better light, and to get rid of all appearances of the operation when it is completed; and, what is my special reason, it secures greater safety to the patient. Some object to this as unnecessary, and say that in most cases the operation had better be performed in bed, as less disagreeable to the feelings of many patients, and as causing "less fuss." Now, my experience is that eventually it always causes "more fuss." It is not easy to get at the patient; the assistants get crowded and awkwardly placed, blood can hardly be prevented soiling the patient's night-dress, and the bed-clothes and the bedding generally get disarranged, so that the after comfort of the patient is interfered with. All this and more serious consequences are avoided by placing the patient on a table, and there is no need for him knowing anything of it. He is put under chloroform in bed; the table is easily arranged in another room, and brought in when the patient is unconscious, and he is lifted from bed and placed on the table. His bed is then properly arranged, so that he is afterwards placed in as comfortable a condition as his circumstances

admit of, and after the operation the table and all the other paraphernalia of the surgeon are at once removed. Supposing the room to be fixed on,—the surgeon chooses a firm table of moderate height, not very broad, and of sufficient length to support the patient. An ordinary stout deal table generally answers all purposes. This table is covered by a folded blanket, protected by oil-cloth or India-rubber web, and furnished with a couple of pillows to support the patient's head. A piece of floor-cloth or old carpet should be placed over the carpet of the room, under and for some distance from the table, to protect the carpet from being stained with blood. In cases of amputation, where there may be considerable effusion of blood, or discharge from the diseased limb, the surgeon should direct the friends or nurse to provide a tray with sawdust, so as to avoid all disagreeables as far as possible, as the sawdust absorbs the fluids, and prevents the risk of their accidental diffusion over the floor. The other preparations to be provided by the family are basins in which to wash the sponges; and plenty of towels, hot and cold water, and a foot or slop pail, into which the soiled water may be emptied. Hot bottles should be ready when the patient is replaced in bed after the operation. The surgeon should never trust to finding sponges provided; he should invariably bring his own, otherwise he will sometimes have to deal with very doubtful articles. In my own practice, I am very particular in regard to sponges. Before being used they should be thoroughly cleansed from all sand or calcareous matter, and after every operation I have my sponges washed in a weak solution of bicarbonate of soda, to remove the blood thoroughly, then in cold water, and lastly, I allow them to steep for a night in a weak mixture of water and hydrochloric acid, and in my private practice I seldom use the same sponges continuously, or for any long period. The number of assistants required will depend upon the nature of the particular operation. In cases of emergency we must do the best we can with what assistance can be procured, but in pre-arranged operations the surgeon should consider what assistance is required, and arrange the number of attendants and their duties

beforehand. Whilst there is no necessity for a large number of assistants, there is often an error committed in having too few, and trusting to unskilled aid, which sometimes fails when most wanted. The patient need never see any one but the operator, and the assistant who administers the chloroform. When he is under the chloroform the other assistants are introduced to lift the patient upon the table, and take the places previously assigned to them. By a little forethought and preconcerted action much bustle is saved. The instruments and dressings required in the operation are prepared beforehand, and arranged on a small tray in another room, whilst the patient is being chloroformed. As a general rule, it is advisable that the after-dressings, ligatures, suture-needles, and the like, be placed on a separate tray from the instruments used during the operation. For night operations small wax tapers should be at hand, as being more manageable and giving a clearer light than a flaring candle. I have found these tapers so useful that they form part of the furnishings of my emergency bag.

3. THE USE OF ANÆSTHETICS is now almost uniformly adopted in all important operations, and the cases in which they are objectionable are so very few and exceptional that they will be better understood when speaking of special operations. I do not intend to enter upon the general question of anæsthesia and anæsthetics; that has been so fully discussed by my distinguished colleague, the late Sir James Simpson, that I need only state what I have found to be the most efficient and safest method of exhibiting them in cases of operation. I would, however, observe, as regards their risks, that whilst we could scarcely expect that an agency so potent as to dull or arrest temporarily all consciousness, should be perfectly free from danger in some cases, or if not carefully watched in its action, yet, when we take into account the many thousand cases in which anæsthetics must have been administered, and the comparatively few cases in which fatal results have occurred, I think we may safely say that few powerful narcotic remedies are so free from danger. And it has been frequently remarked that the great majority of the fatal results have occurred during the

performance of slight operations, and when the patient has been placed in the sitting posture. At the same time, all due precautions should be taken, such as examination of the circulatory organs in suspected cases, and preparation of the patient prior to the operation. When the patient has a weak heart and feeble pulse, or is advanced in life, I usually mix a little anhydrous sulphuric ether with the chloroform, or begin by the administration of chloroform, adding the ether if the pulse shows a tendency to flag. The stimulating effect of the ether under such circumstances is very noticeable; although for general use the chloroform answers far better. As to the quantity to be administered, that must be judged of by the effect. I would only remark that there is often greater danger from beginning with small quantities than by bringing the patient rapidly under its influence. Measurement of the chloroform used, is merely to give an appearance of precaution, and, I presume, to enable the surgeon to be prepared for a coroner's inquest.

In the Edinburgh Infirmary no special apparatus is employed; merely a folded towel or handkerchief; or, when the "drop system" is adopted, a single fold of the handkerchief or cloth is placed over the mouth and nostrils, the face having been previously smeared over with lard or oil to prevent the skin being irritated. When the ordinary method is employed, the handkerchief is folded into a hollow cone, into which the chloroform is poured so as to wet the interior, and the cone is then placed over the mouth and nostrils. When renewing the supply of chloroform in this method, it is advisable not to remove the cone from the mouth, but merely to open up a part of the outer fold and pour the chloroform on the inner fold. When the "drop system" is used, a little chloroform is poured on the handkerchief at first, and then continuously applied, drop by drop, till the full effect is produced. When a patient is to be operated on under the influence of chloroform, no food should be given for at least three hours before the operation, so as to allow the stomach to be empty, and thus diminish the inconvenience and risks of

vomiting. A little brandy, diffused in a small quantity of water, may be taken about quarter of an hour before the chloroform is inhaled. This is useful both as a stimulant to the circulation and also in obviating flatulence, which is apt to occur in some patients when the stomach is empty, and, when present, leads to retching and attempts at vomiting. In the Royal Infirmary, where the usual hour for operations is twelve o'clock noon, the patient gets a light breakfast about a quarter to eight o'clock, so that fully four hours elapse before the anæsthetic is administered. I have spoken of the *risk* of vomiting, for there is great risk of a portion of the vomited matter passing into the larynx, and leading to suffocation, as the symptoms of asphyxia might be attributed to the chloroform, and time lost in attempting artificial respiration. In cases of hernia, where vomiting is present independently of the effects of the anæsthetic, great attention is required on the part of the assistant to keep the patient's head and neck lying on the side, so as to allow the vomited matter to pass easily from the mouth, which it cannot do when the head is lying back. When, after an attack of vomiting, sudden symptoms of asphyxia occur, I think the proper plan would be at once to perform laryngotomy in the crico-thyroid space, and allow air to enter the trachea; because, if any solid matter has entered the larynx or trachea, the peculiar sensory and expulsive powers being diminished during anæsthesia, the foreign body is not expelled, as it might be under ordinary circumstances.

In all cases of important operations the patient should be placed recumbent. All articles of dress which constrict the neck or waist, or may in any way impede the free movements of the chest or abdomen, should be loosened or removed. The state of the pulse should be ascertained before beginning the inhalation, and carefully watched throughout. Immediately before applying the chloroform, the patient is desired to take a deep inspiration, and then to continue to draw in full breaths quickly after the chloroform is applied. By doing this, less chloroform is required to produce the desired effect, and the assistant administering it watches carefully the effects produced. In almost all cases there

is more or less struggling just before the patient gets fully under the effect of the anæsthetic. Then the breathing becomes stertorous, but regular; the eye and eyelid insensible to the stimulus of touch, and the limbs become flaccid. The symptoms which indicate danger are—extreme lividity, irregular gasping breathing, but more especially pallor, and irregular weak pulse, or sudden cessation of the wrist pulse. Stertorous breathing, so long as the respirations are regular, is not necessarily a symptom of danger, it merely shows that the patient is deeply under the anæsthetic. The chloroform cloth may be removed to a greater distance from the mouth to allow free admixture of air, or its use may even be intermitted; but unless the breathing be irregular, or become stridulous or gurgling, with increased lividity of the face, there is no need to interfere.

When the breathing becomes irregular, gasping, gurgling, or very stridulous, and the face livid, remove the chloroform, draw forward the tongue, pass the finger into the mouth to clear away any mucus over the glottis, push away the uvula and soft palate upwards to avoid its interference with the opening of the larynx, and sprinkle cold water on the face and chest, or flip the surface with the end of a wet towel. At the same time, artificial respiration, by means of gentle and regular pressure on the walls of the chest, not too forcibly or rapidly applied, should be used; or the same end may be effected by the assistant drawing the arms upwards above the head, and then pressing them down by the sides of the patient, so as to make alternate compression and expansion of the parietes of the thorax. Whenever the lips or face are seen to become pale, and the pulse to flag in strength or to become irregular, the chloroform should be stopped, and sulphuric ether substituted, cold water sprinkled on the face, and artificial respiration begun. The case is one of imminent danger. Whilst these means are being used, a small enema of brandy and warm water should be administered as a stimulus. If the patient be carefully watched, and the administration of the ether begun when any weakness of pulse is noticed, it will generally suffice

to restore the force of the circulation, and prevent the accession of the dangerous symptoms. Galvanism has been recommended and used. If applied, the current ought not to be directed through the chest, so as to affect the heart, or it may do more harm than good. It should be applied to the cervical region, so as to pass along the course of the phrenic nerve. But I should hardly advise its use, as it is likely to interfere with the other and more efficacious measures for resuscitation of the patient.

In my own practice I have met with one fatal case resulting from chloroform. The operation—amputation of the penis—was effected with one stroke of the knife. No blood flowed, the pulse at the wrist had ceased in an instant, and all efforts to resuscitate failed. Breathing, though of a gasping character, was present when the artificial respiration was commenced. In another case, in which I was assisting, I had my finger on the posterior tibial artery. The patient was just brought under the chloroform, and the operator had entered the knife through the skin, when the pulse, without any previous diminution in strength, ceased to beat. In both these cases there was fatty heart. I have, however, both in my own practice and that of others, seen some patients, who seemed to be in a fatal syncope, resuscitated by the measures I have advised. Almost all the cases in which the dangerous symptoms occurred were cases of slight operations. But, after all, the risks of danger are very small if the administration be watchfully and properly carried out.

As to its after-effects, the worst are the nausea and vomiting which often result from its employment; and in some operations, such as hernia, this vomiting may prove serious. In most cases, sucking a little ice, or a dessert-spoonful of iced brandy and water given occasionally, and the application of a sinapism over the epigastrium, serve to relieve the sickness. When the nausea and retching continue, a draught of tepid water, to assist the effort of vomiting to empty the stomach, is often of use, and this may be followed by a small opiate to allay

irritation and procure rest. It has been stated that, whilst the use of chloroform and other anæsthetics has done so much to facilitate the performance of operations and save the patient from suffering, they have given rise to greater danger after the operation, that the mortality is increased, that cases do not get on so well as formerly, and that pyæmia especially is much more heard of now than before anæsthetics were used. All this is mere assertion, without any distinct proof. And as I have had experience in performing and witnessing operations, both before and since the use of chloroform, I feel satisfied that the very opposite is true; that operations are very much more successful in their results than before the use of anæsthetics. The patient is saved both the physical and moral shock inseparable from great operations formerly, and which depressed him and exercised an influence for evil on the result. I was amongst the first to use chloroform in a great operation in November 1847; and since then I have used it, and seen it used, in almost all operations, great or small. I feel satisfied that, instead of diminishing, it has greatly advanced the successful results of operations. It is true, we hear more about pyæmia now than we did thirty years ago, because the name is comparatively a new one; but the same condition existed under different titles:—exhaustion, surgical fever, secondary abscesses, icteric irritative fever after operations, rigors, from exposure at “open windows” (a condition once remarkably fatal in “successful cases”), and acute sinking—will be found to correspond wonderfully in symptoms, results, and morbid appearances, to the modern pyæmia. Indeed, it is only of very recent date that some surgical authorities have admitted the term pyæmia into their vocabulary—“exhaustion,” or “acute sinking,” having been found to answer all purposes equally well.

4. THE OPERATION.—The general principles to be attended to must be very briefly stated here, for so much depends on the nature of the operation, that they are better brought out in their relation to special operations. The plan or method

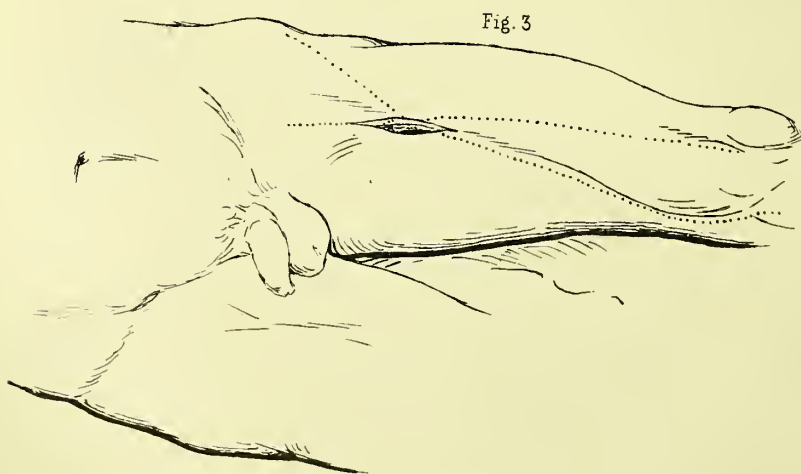
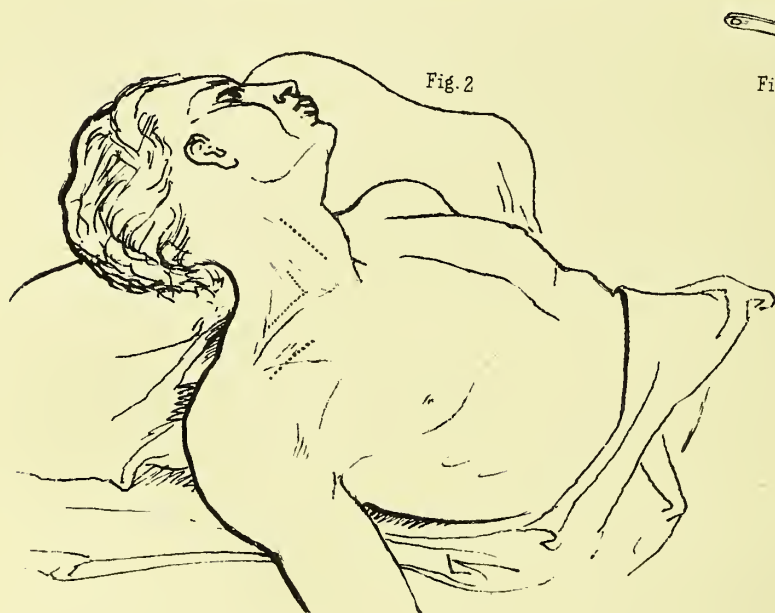
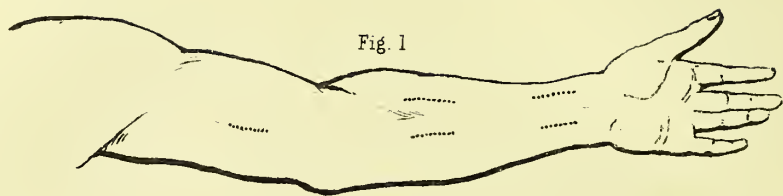
of operating should be carefully considered and decided on beforehand, so that the incisions may be effected rapidly (not hurriedly), with decision and precision, every touch of the knife telling towards the accomplishment of the object in view. If the plan be not decided on, confusion, and a want of decision in operating, and loss of time, will be the almost inevitable result. If the steps of the operation be duly planned beforehand, all will be executed with decision, simplicity, and safety to the patient. The assistants should have their several duties assigned beforehand, and their places arranged, so that they may not interfere with the operator, or each other, but that all may act in concert. The incisions should be free, deep, and directly from the surface towards the deeper parts, without lateral dissection, except in particular operations, such as those for the removal of tumours. In certain operations where it is important to recognise readily the deep textures, such as in hernia, ligature of arteries, or in the removal of some tumours, it will save time in the end to pause and secure the small vessels which bleed, so as to prevent oozing of blood into the deep part of the wound, which, by infiltrating the cellular tissue, renders it difficult to recognise textures. Besides, small vessels, which are easily seen and tied at first, soon cease to bleed actively during the operation, and are consequently often left unsecured, and bleed again on reaction taking place; and in cases of hernia, or in other operations near the great cavities or canals, they may bleed into the cavity and give rise to serious risk. When the operation is completed, the wound should be washed by pouring first tepid and then cold water, from a jug, over its surface, to remove all clots and arrest oozing. The edges of the incision are then approximated by points of interrupted suture, or harelip suture. In some cases we only introduce the sutures, leaving the ends long without tying them, so that if any oozing occurs it may be noticed and arrested. After six or eight hours, any clots of blood which may have formed are gently removed with a bit of soft sponge and by syringing out the wound, and then the incision is finally closed, and the local treatment conducted on the

principles laid down when speaking of incised wounds (Lecture xxvii.)

5. CONSTITUTIONAL AFTER-TREATMENT.—When the patient awakes from the chloroform, an opiate is given to allay pain and to prevent the restlessness which would otherwise be sure to take place. Should sickness from the chloroform supervene, as already stated when speaking of anæsthetics, I advise the use of tepid water to render the efforts of vomiting less violent, and to empty the stomach, and then a little brandy in iced water may be given. If the nausea continue, a sinapism applied to the epigastrium, and a little ice kept in the month and slowly sucked, or small quantities of iced aërated water, will usually arrest it. In some cases, where the patient does not vomit, the nausea may continue for some time, and, unless attended to, may prove troublesome by depressing the patient. During the progress of the case opiates are given at bed-time, if required to obtain sleep, but the sooner we can dispense with their use the better. In some patients, in whom there is much nervous excitement, the use of the bromide of potash in 30-grain or 40-grain doses, at bed-time, is often of great service in procuring sleep, and enabling us to dispense with opiates. As to diet, it should be simple, light but nourishing, and given at first in small quantities, frequently. For a day or two it is probable the patient may not be able to take anything but milk diet. Milk beat up with the white of eggs and a little lime-water will often remain on the stomach when all other food is rejected, and milk with aërated potash water is also much relished by patients. So soon, however, as the patient can bear it, strong beef-tea, with extract of beef, should be given, or a little white fish, and afterwards, as the appetite improves, chop or steak is preferable to slop diet. As regards the exhibition of stimulants, that must be regulated by the condition of the patient, the state of the pulse, and the appearance of the wound. No routine practice should be followed. In my hospital practice I find myself forced to give stimulants largely, owing to the exhausted state of the patients, their inability to take nourishing

food, and not unfrequently from their previous habits, or from want of action in the wound. In private practice stimulation is not often needed, and I feel satisfied that the routine practice of giving stimulants in all cases of great operations is not only unnecessary but dangerous, as over-exciting the circulation, keeping up the pulse, and proving detrimental to internal organs. If the patient has a moderately firm pulse, and can take nutrient diet, the amount of wine or brandy he requires is very little, if any.

Should the pulse keep high, or show a tendency to rise, the remedy of all others which I have found of most use as counter-acting this condition, and relieving the febrile state which accompanies it, is the tincture of aconite (*Fleming's*) in half-minim or minim doses, every three or four hours, watching its action carefully, and leaving off its use whenever the pulse lessens in frequency. During the after-progress of the case, when the tongue is clean, the use of quinine with compound infusion of gentian, and either dilute hydrochloric, nitric, or nitro-muriatic acid, will be found of use as tonics; and in cases where there is any want of action in the stump, the exhibition of such tonics is often attended with marked benefit. In very weakly strumous patients, or where, from the nature of the disease requiring the operation, we dread pyæmia supervening, the muriated tincture of iron, and moderate doses of chlorate of potash, may be given; but should the iron produce nausea it must be abandoned. Of course the state of the bowels and the urinary secretion must be carefully attended to during the progress of the case; and at first, shortly after the operation, the action of the bowels should be assisted by enemata to prevent straining; and, after ligature of great arteries, or in the larger amputations of the lower extremity, the same precaution should be used at the period when the main ligatures may be expected to separate.



LECTURE LXXV.

Operation for the Ligature of Arteries—Importance of a Knowledge of the Relative Anatomy of the Part to be operated on—Nature of the Incisions required—Exposure of Artery : Opening of Sheath—Passing of Needle—Apparatus required.

Ligature of Innominate Artery—Ligature of the Common Carotid Artery—Ligature of the First Part of the Subclavian Artery.

As I have fully discussed the effects of ligature of arteries, and the injuries and diseases of the arterial system which require surgical treatment, I now proceed to describe and demonstrate the operative procedures for applying the ligature to the principal arteries. It is not my intention to describe the various methods which have been adopted by different surgeons, but rather to employ the time allotted to this part of the course to careful and accurate demonstration of the points most essential to be attended to, in what from experience I have found to be the best plans of procedure. In every surgical operation a thorough knowledge of the structure of the parts to be operated on is necessary ; but in very few operations is it so necessary as in those performed with the view of reaching and tying important arteries. In these operations it is generally amongst organs of vital importance that the surgeon has to direct his instruments, so that by carelessness or the least deviation he may wound structures essential to life. And in all cases, uncertain and difficult manipulations, if they do not lead to immediately fatal accidents, are almost sure to be followed by secondary hæmorrhage.

Surgical anatomy, then, consisting of an accurate knowledge of relative anatomy, and of the functions of the different structures likely to be implicated in the operation, is the only secure basis on which to practise the operations on arteries. And I shall therefore preface each operation by a brief but careful examination

of the anatomy of the parts, in so far as these have essential bearings on the operative procedure ; whether as affording guides to the vessels to be tied, at different stages of the operation, as enabling us to avoid injury to important structures, or as facilitating the deligation of the artery.

When speaking of operations in general, I stated that the operative manipulations would be better understood when speaking of special operations. I shall now, therefore, state what I consider are the points to be principally attended to in operations for ligature of arteries.

The great object in view is to expose the artery to be tied, with the least possible disturbance of parts, more especially of those parts immediately surrounding the vessel, so as to avoid the risk of secondary hæmorrhage. This object is best accomplished by cutting down directly from the surface towards the vessel, avoiding as far as possible all lateral dissection or separation of the superimposed textures. The superficial incisions should be free, so as to diminish the depth of the wound, and, with a few exceptional cases, this free division of the superimposed textures should be applied to the deeper fasciæ and structures covering the sheath. If this principle be not attended to, the wound becomes more and more contracted as the operator proceeds deeply, till at last, and at the most important stage of the operation, he will find himself working in a deep hole, in which his manipulations are confined, and the textures only imperfectly seen or felt. By attending to the rule of free division, the oozing of blood gets vent externally, the parts are fully exposed, and their position rendered less deep. Even as regards the sheath of the artery itself, opening it somewhat freely, or cutting out an oval portion of it on its superficial aspect, will entail no danger, if the operator is only careful not to separate it largely in clearing the circumference of the artery for passing the ligature. During the incisions all bleeding vessels should be twisted or tied, to avoid the blood infiltrating the textures in the wound. In opening the sheath of the artery, the surgeon should carefully raise a portion in his dissecting forceps, and then either

slit it open for about a quarter of an inch, or, placing the edge of his knife horizontally, cut out an oval portion of the sheath to the same extent. He should next carefully separate the margin of the sheath, and fix it by seizing it with a pair of artery forceps which are left on until the vessel is cleared and the ligature completed. This little manœuvre prevents the original opening of the sheath being lost sight of, should the patient move or the parts get displaced, and it also does away with the necessity for the fingers of an assistant to hold aside parts. The mode of applying the forceps to the edge of the opening in the sheath will be understood by reference to the sketch of the ligature of the femoral artery. Plate xxix. Fig. 2.

When the sheath is thus opened, the surgeon, with the point of the scalpel, clears the circumference of the artery to the extent of a line or two in breadth, so as to admit of the aneurism needle being passed without any force. In passing the aneurism needle, the handle should never be forcibly depressed with a view to make its point project, for that elevates the artery from the sheath and breaks up its fine vascular connections. The needle should merely be insinuated below the vessel, till its point is seen on the opposite side, and then the thread is seized with the dissecting forceps and held whilst the needle is withdrawn, so that all unnecessary disturbance of the artery is avoided. After ligature of the great arteries supplying the extremities, the wound is merely covered with lint, supported by strips of adhesive plaster, and the limb enveloped in a sheet of cotton wadding, and laid on a water pillow or some soft cushion to avoid pressure.

The apparatus required for ligature of arteries is very simple. Besides the ordinary dressings, sponges, and other requisites for all operations, the special instruments needed are a sharp-pointed scalpel or small bistoury, a probe-pointed bistoury, which may occasionally be required; dissecting forceps, artery forceps, and torsion forceps; blunt hooks or bent metallic spatulæ for holding aside the textures; an aneurism needle, armed with fine ligature silk.

Some surgeons, more especially on the Continent, use a grooved director on which to divide the fascial textures and the sheath, but it really affords no safety, and ought to be dispensed with, as the fasciæ in the important parts of the operation are better divided with the hand unsupported and uninfluenced by a mechanical guide.

The aneurism needle should be of the form shown in Plate xxvii., the point rather short from the curve. The eye of the needle should be near the point, and well finished, so as not to cut or fray the ligature. The point of the needle should be smooth and blunt, but not thick, so that it may be easily passed under the artery without risk of piercing the neighbouring vein or other important texture. For the ligature of some deep-seated arteries—as, for example, the subclavian—when the shoulder and clavicle are much elevated, a needle with a double curve may be required, the concavity of the curve nearest the handle playing on the clavicle, so as to enable the point to be passed more easily round the artery, that it may appear at the opposite side without raising the vessel from its connections. If the ordinary aneurism needle, however, be so tempered as to allow some slight degree of flexibility, the surgeon can curve it to suit particular cases. I have always had my own aneurism needles constructed on this principle, and also grooved behind the eye to receive the thread. Not that I consider this of any consequence, but finishing off the groove necessitates care in finishing the eye of the needle, which I have often seen a mere rough perforation.

In cases in which we are about to apply the ligature to an artery for true aneurism, we must be careful, whilst bringing the patient under the influence of chloroform to compress the vessel nearer the heart; for when the patient struggles, and the muscles become rigid, the sac often becomes so tense that there might be a risk of its rupture taking place, unless such precaution were taken.

I shall first describe the operations for ligature of the principal arteries supplying the head, neck, and upper extremity, and afterwards those of the abdomen and lower extremity.

THE INNOMINATE ARTERY, though deeply seated, is not so complicated in its relations, but that it can be readily reached and tied. The vessel is very short—not much more than about an inch and three-quarters in length. It arises from the right side of the arch of the aorta, and passes obliquely upwards as far as the right sterno-clavicular articulation, where it ends by dividing into the right subclavian and the right carotid arteries. It is sometimes called the brachio-cephalic artery, from the distribution of its terminal branches. In its upward course the artery rests for some little distance on the trachea, and is covered by the first bone of the sternum, and by the sterno-hyoid and sterno-thyroid muscles. In this substernal region the artery is crossed by the vena innominata of the left side, which is formed by the junction of the left internal jugular and subclavian veins. Higher up in the cervical region the vena innominata does not cover it. The artery then passes into the lower part of the cervical region, and a small portion of it can be seen by separating the sterno-hyoid and sterno-thyroid muscles. The vessel here lies very deeply, though the textures between it and the surface are not numerous. These are the skin and fascia, with the sterno-mastoid, sterno-hyoid, and sterno-thyroid muscles, and a quantity of loose cellular tissue. It is this part of the vessel that we reach by tracing downwards from the right carotid artery. Its surface corresponds to a quantity of loose cellular tissue and glands, in which lie several large veins returning from the thyroid body. These thyroid veins form a sort of network over the upper part of the space in which the artery lies. The innominate artery is also related to the right vena innominata—the vein being to the right side of the artery, and in close contact with the right side of the vessel is the right pleura.

Operation.—An incision, about two inches long, is made over the inner part of the clavicle, towards the sterno-clavicular articulation, and another, two and a half or three inches in length, along the internal margin of the sterno-mastoid muscle, at its lower part, to meet the former, where it terminates at the sternum. The skin, fascia, and inner attachment of the sterno-mastoid are then de-

tached, so as to be thrown backwards in the form of the flap marked out by the incisions. The internal jugular vein and the root of the right common carotid artery, covered by the deep fascia, are now brought partially into view. The sterno-hyoid and sterno-thyroid muscles should be cut across, so as to expose the deeper parts more fully. The head should be drawn somewhat back, as this allows the innominate artery to be drawn up into the neck, while the left vena innominata, which covers the artery, being fixed by its relations to the right vena innominata and superior vena cava lower down, can scarcely be dragged above the sternum into the right side of the neck. A little deeper dissection is then made, and the artery cleared from the surrounding textures. In doing this great care must be taken to avoid the right pleura, which lies below and to the right side of the vessel. The needle is then passed below it, still taking care to avoid injuring the pleura.

The operator should gently trace the surface of the vessel till he distinctly feels its bifurcation, so as to make sure that the artery exposed is the innominate and not the lower part of the carotid, or in case of any irregularity. In performing the operation on the subject before my class, on one occasion, and inculcating the same precautions as I do now, I could not feel the bifurcation. I therefore desisted from farther interference, and had the subject injected. The preparation is now on the table, and you will perceive that there is no innominate trunk. The right subclavian arises from the left side of the arch of the aorta, passes between the œsophagus and vertebræ, and so arrives at the right side of the neck. When there is any difficulty in reaching the innominate, you will find it by tracing the right carotid down to its origin, the simplest and surest method of reaching the trunk common to it and the right subclavian.

THE COMMON CAROTID ARTERY has been so repeatedly tied for aneurism, erectile tumours, and other causes, that no one would now hesitate to tie it from any fear of the effects which the operation may have on the cerebral circulation.

Although the anatomical relations of the right and left

carotid arteries are very different in the first part of their course, owing to the difference in their mode of origin, yet, in the cervical region, where the surgeon has to deal with them, these differences almost disappear. In the lower anterior triangle of the neck, the right common carotid is more superficial than the left, owing to its origin from the innominate trunk, which lies in front of the trachea, whilst the left carotid in this region has a closer relation to the œsophagus on its internal aspect, and at the very lowest part of the cervical region the thoracic duct corresponds to its external side. But in other respects, and higher up in the neck, their relative anatomy is very similar. The general course or position of the common carotids in the neck is indicated by a line drawn from the sterno-clavicular articulation to a point nearly midway between the angle of the lower jaw and mastoid process. The vessel divides into its great terminal branches, the external and internal carotids, at a point a little higher up than the upper margin of the thyroid cartilage. In the neck, the primitive carotid artery is inclosed in a common sheath, which contains the internal jugular vein and pneumo-gastric or vagus nerve. This common sheath rests upon the front of the cervical vertebræ, and more immediately upon the longus colli muscle, and, higher up, upon part of the rectus capitis anticus. Between the sheath and these muscles there is a quantity of fine connective tissue, which permits of free movement of the parts lying in front of the vertebræ. The cervical portion of the great sympathetic nerve also corresponds to the posterior aspect of the common sheath. On the mesial side of the sheath are the larynx and trachea, the lower part of the pharynx, and the œsophagus—the last-mentioned structure being more directly in relation to the left than to the right carotid. The superior and inferior laryngeal nerves pass behind the sheath in the course which they take towards their destination, and the inferior thyroid artery also crosses behind the sheath, and then corresponds to its inner aspect. Still more deeply, at the lower part of the neck, a chain of lymphatic glands lies to its inner side. On its outer or distal side

the sheath is in relation with the origin of the scalenus anticus. The common carotid artery, vagus nerve, and internal jugular vein, whilst included in the common sheath, lie each in a separate compartment; the septa between them being pretty strong and distinct, more especially as regards the compartment which contains the artery, so that we may expose the carotid without interfering with the vein and nerve. The artery lies in the inner compartment, *i.e.* nearest the mesial line of the body. The internal jugular vein lies most external, whilst the vagus lies between, and on a plane posterior to both. At the root of the neck, on the right side, the nerve is more exposed between the vein and artery, from the somewhat oblique upward course which the latter takes from its origin from the innominate. The coverings of the sheath vary at different parts of the neck. In the lower anterior triangle we have the skin, superficial fascia, and a few of the lower and inner fibres of the platysma; the layer of the deep fascia covering the sterno-mastoid and the inner head of that muscle, the sterno-hyoid and thyroid muscles, and the deeper layer of the cervical fascia from which the sheath is derived. Immediately above this point the sheath is crossed by the tendon and anterior belly of the omo-hyoid muscle, which passes from below, upwards and inwards, to reach the body of the hyoid bone, and forms the boundary between the superior and inferior carotid triangles of the neck. If we draw aside or divide the omo-hyoid, we see the lateral lobe of the thyroid gland, which generally overlaps the inner surface of the sheath. Above the point where it is crossed by the omo-hyoid muscle, the common sheath is only covered by the skin, platysma, and the superficial and deep fasciæ of the region. Branches from the superior thyroid artery to the sterno-mastoid muscle cross it obliquely from above, downwards and outwards. The descending branch from the ninth cranial nerve passes down in front of the sheath, and a little above the point where the omo-hyoid crosses the sheath. This nerve forms a loop-like junction or plexus with the anterior branch of the second cervical nerve, the branches from which pass to the tracheal muscles. In many cases, however, the

“descendens noni” is covered in by a layer of the sheath at the upper part of the neck.

The anastomoses to which we trust for re-establishing the circulation, after ligature of the common carotid, are so numerous, that we need have no anxiety on that point. We have—1st, The anastomosis between the superior thyroid branch of the artery which has been tied with the thyroid of the opposite side, and both anastomose freely with the inferior thyroids of the subclavian. 2d, The lingual, on the side tied with that of the opposite. 3d, The anastomosis between the facial arteries. 4th, The inosculations between the occipital arteries of opposite sides, and of the occipital with the vertebral. 5th, The terminal branches of the external carotid—viz. the transverse facial, internal maxillary, and superficial temporal arteries—anastomose freely with the corresponding vessels of the opposite side; whilst, as regards the cerebral circulation, we have free anastomoses between the vertebral arteries and the internal carotids, through the circle of Willis within the cranium.

Operation.—The operative procedure adopted for tying the common carotid artery has been almost uniformly the same. An incision at least three inches long is made along the inner margin of the sterno-mastoid muscle, commencing higher or lower in the neck according as it is our intention to tie the vessel above or below the omo-hyoid. As the general course of the common carotid is indicated by a line drawn from the sterno-clavicular articulation to a point a little behind the angle of the lower jaw, whilst the anterior margin of the sterno-mastoid is indicated by a line from the sterno-clavicular articulation to the anterior margin of the mastoid process, it follows that as the vessel passes higher in the neck, the muscle diverges from the artery and corresponds rather to that part of the sheath containing the jugular vein, than to the compartment enclosing the carotid. Hence, in tying the artery above the omo-hyoid we should make our incision nearer the mesial line, more directly over the line of the vessel, and not follow closely the oblique line of the margin of the sterno-mastoid.

The patient should be placed with the shoulders moderately raised, the head supported by a pillow, the neck slightly stretched, and the face turned to the opposite shoulder, so as to make tense the sterno-mastoid. The surgeon should next compress the neck at the lower part, to make the superficial veins turgid, and thus ascertain their course in each individual case, so as to avoid them, or tie them previously to dividing them if necessary.

Having indicated this precaution as requisite in the living, I now make an incision in the line previously described, through the skin, platysma myoides, and superficial fascia. Commencing on a level with the upper part of the thyroid cartilage, I carry the incision downwards for three inches. When the skin and platysma are fully divided, my incision brings into view the deep fascia. That structure I next divide along the anterior edge of the sterno-mastoid, in the line and to the full extent of my superficial incision. This exposes the margin of the sterno-mastoid. A few light touches with the point of the knife divide any resisting connections, and with the ivory handle of the scalpel I now gently separate the loose cellular tissue, so as to enable me to draw the overlapping edge of muscle slightly aside by a blunt hook. You now observe a layer of the deep fascia covering in and binding down the omo-hyoid and other tracheal muscles and sheath of the vessels; the sheath being merely covered by this fascia at the upper part of the incision. I proceed to divide this fascia by raising a portion of it over the omo-hyoid, opening it with the point of the knife, and then slitting it open upwards and downwards. The muscular fibres of the omo-hyoid are now exposed and bare, and higher up the proper sheath of the vessels, more or less overlapped towards the mesial line by the lateral lobe of the thyroid body. This latter structure is drawn aside by a blunt hook. The sheath, now fully exposed, is opened carefully by raising a portion of it which lies immediately over the artery with a pair of dissecting forceps, and you will observe that I apply the edge of the knife horizontally, so as to cut out the portion raised without risk to the subjacent vessel. This manœuvre results in a rounded opening or hole in the sheath. I

clear the internal edge of this opening from the vessel, lay hold of it with a pair of artery forceps, so as to fix it, and give the forceps to an assistant to hold the edge gently, or simply let the forceps hang across the neck, and hold the margin aside by their own weight. I next seize the outer margin of the opening of the sheath with the dissecting forceps, and clear the vessel to a very small extent from its cellular connections, but thoroughly, so as to enable me to pass the armed aneurism needle round the vessel without any force. If I meet with any resistance, I withdraw the needle and clear the vessel a little more. When I see the point of the needle on the inner side of the carotid, I do not, you will notice, depress the handle so as to elevate the point from the wound, as that raises the vessel too much from its sheath, and is apt to tear and destroy its vascular connections. I merely keep the needle firm, and with the dissecting forceps seize the ligature and hold it, whilst I withdraw the needle. The point of the aneurism needle should always be passed from the outer side of the vessel, so as to avoid risk of injury to the jugular vein. If care be taken to open the sheath directly over the artery, and to keep the point and surface of the needle close to the coats of the vessel in passing round it, there is no risk of including the vagus nerve or injuring the vein. In my own experience in tying the carotid in the living I have felt the vein in the sheath, but have never seen it bulge over the artery. If, however, the sheath be opened so as to expose the vein, it will be more likely to overlap the artery and give trouble to the operator. The operation I have now demonstrated is that for ligature of the carotid above the omo-hyoid. (See Plate xxviii. Fig. 1.) When we require to tie the vessel lower down, we extend the incision downwards along the edge of the mastoid, and draw that muscle more fully aside than in the former operation; and now you will observe I divide the fascia which covers the omo-hyoid, and separate the connections of that muscle with the sterno-hyoid and sterno-thyroid. The omo-hyoid is then drawn upwards, and the sterno-thyroid drawn inwards. (Plate xxviii. Figs. 2 and 3.) The sheath is thus exposed, but much more deeply seated than

in the higher operation. In the living subject, when the neck is short and the omo-hyoid broad, it forms a considerable obstacle to dealing with the sheath and clearing the vessel ; and I have had occasion to divide a few of its fibres to gain room. Indeed, rather than tie the artery very low down, or have much difficulty or manipulation in the deep part of the dissection, I would strongly advise complete division of the anterior belly of the omo-hyoid, to expose the vessel easily and lessen the depth of the wound, and to render the operation less dangerous.

In one case in which I required to tie the left common carotid very low down, in a man with a short muscular neck, I found great difficulty in drawing aside the inner margin of the sterno-mastoid, which stood out in strong relief and deepened the wound. This was before the days of chloroform ; but still, were I now called on to operate so low down in the neck, I would make a small incision at a right angle with the cervical incision, so as to divide the skin and internal origin of the mastoid muscle, and reflect the flap thus formed, as in ligature of the innominate artery, so as to simplify the operative procedure.

M. Sedillot has proposed to reach the carotid artery by an incision between the sternal and clavicular attachments of the sterno-mastoid muscle. Such an incision, however, would correspond rather to the compartment of the sheath containing the jugular vein, than the artery, and the operation in the living would be more difficult, owing to the restricted space between the separated portions of the muscle ; and I therefore consider the ordinary method, with the modifications I have indicated in certain circumstances, as the best to be followed.

When the operation is concluded, the head should be bent slightly forwards to relax the parts and prevent tension of the deligated vessel. To fix the head in this position a circle of bandage round the head is connected with slips of bandage fastened to a broad circular bandage round the chest, and the patient is placed in bed with the head and shoulders raised. An opiate should be given, and some anodyne linctus, such as some emulsion containing small doses of hydrocyanic acid, or other

Plate XXVIII

Fig. 1



Fig. 2

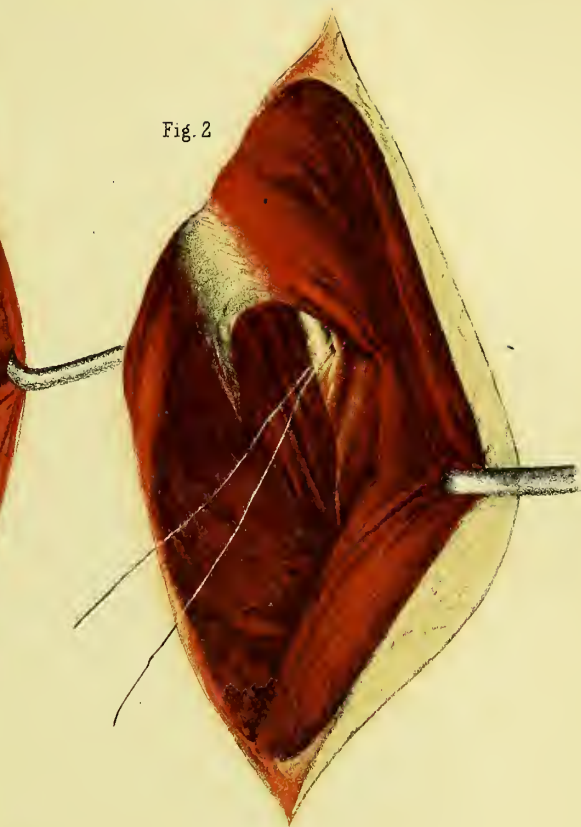


Fig. 3

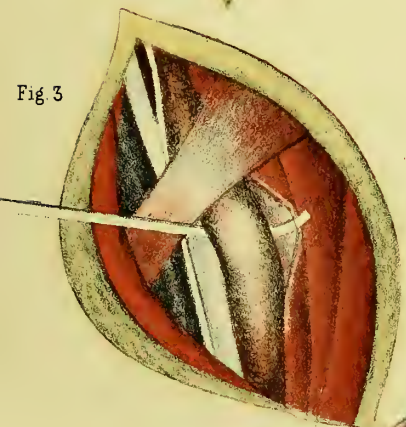
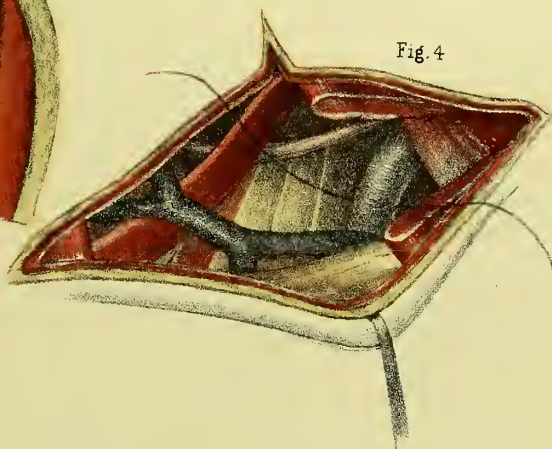


Fig. 4





sedative, to prevent or allay laryngeal irritation. When, however, irritation has led to symptoms of pulmonary congestion, I have seen marked benefit follow venesection, with relief of the urgent symptoms.

The diet should at first be nutrient, but non-stimulant, such as whites of eggs with milk, and farinaceous diet. White fish, and fowl or other animal food of a more stimulating nature, may be gradually given.

The first or internal portion of the SUBCLAVIAN ARTERY extends from the origin of the vessel to the inner margin of the anterior scalenus muscle. On the left side this part of the vessel, as it ascends from the thorax, is so situated as to be scarcely in the cervical region, and is consequently beyond the reach of surgical operation.

On the right side, owing to the manner in which it arises from the innominate artery, this part of the subclavian is placed in the neck, but is most unfavourably situated for the application of the ligature, whether we regard its complicated relations to important structures or the numerous branches given off within so short a space. From its origin till it reaches the edge of the scalenus anticus, the first part of the right subclavian is not more than an inch and a half in length, and in this space it gives off the internal mammary and vertebral arteries, and thyroid axis. These large collateral branches form a very great disturbing force on the distal side of the ligature, and so prevent the hæmostatic process taking place; while, on the proximal side, we have the force of the cardiac circulation through the innominate and right carotid arteries. The relations of the first part of the subclavian artery are also much more complicated than those of the innominate artery. This part of the subclavian is crossed in front almost immediately after its origin by the vagus nerve, whilst the recurrent laryngeal branch of that nerve curves round it, so that both these important nerves are in close contact with the vessel. Upon it and the innominate artery also lie the cardiac branches of the vagus. Immediately external to the vagus the

internal jugular vein crosses and covers the artery, whilst below the vessel is in relation to the commencement of the right vena innominata. This part of the subclavian is also in close contact with the pleura, and with the great vertebral vein. The latter is very troublesome in the operation, and cannot well be drawn aside, from its being fixed.

In most cases of subclavian aneurism, where any artery has been tied, the innominate has been the vessel chosen, for the reasons before given ; but when the first part of the subclavian is to be tied, nearly the same incisions are required as in the former operation :—one over the inner part of the clavicle, dividing both origins of the sterno-mastoid; and another along the anterior margin of the sterno-mastoid, taking care to avoid the external jugular vein, which lies along the outer edge of the muscle. The artery is then exposed by careful dissection, and important structures held aside till the aneurism needle is passed below it and the ligature secured. It might be thought that the chief danger in the operation would be the sudden interruption of the supply of blood to the parts furnished by the subclavian ; but the real danger consists in the tendency which the free and forcible circulation around the deligated point has to disturb the subsequent hæmostatic process.

LECTURE LXXVI.

Ligature of the Middle and Third Portions of the Subclavian Artery—Ligature of the Axillary Artery in First, Second, and Third Portions—Ligature of the Radial Artery at Superior and Inferior Parts—Ligature of the Ulnar Artery.

ON reaching the anterior scalenus, the subclavian artery passes behind that muscle, and is directly covered by it until it emerges from behind its outer margin to gain the first rib, on the surface of which it continues to rest until, after passing from off the rib, it receives the name of axillary.

That portion which lies behind the scalenus is termed the middle portion of the subclavian, and is covered by the whole breadth of the anterior scalenus, and its course is crossed obliquely from above, downwards and inwards, by the phrenic nerve which rests upon the scalenus. The subclavian vein lies lower down towards the chest, resting on the anterior and inner part of the costal attachment of the scalenus, whilst more superficially this part of the vessel corresponds to the clavicular attachment of the sterno-mastoid muscle, platysma, and skin. In this part of its course the subclavian gives off two branches, or more generally a short common trunk dividing into two branches—the ascending deep cervical, and the subclavian intercostal. This middle portion, then, is very deeply seated ; its lower surface is in close relation to the pleura, whilst the phrenic nerve crosses its course in front. The third or outer part of the subclavian, commencing where the artery emerges from beneath the cover of the scalenus, is only covered by the skin, platysma, and superficial deep fasciæ of the neck ; but still, owing to the arch formed by the clavicle, the vessel lies very deep. As this is the part of the subclavian which is most frequently the subject of surgical operation, we require to consider its relations very carefully.

The external third of the subclavian artery is situated in what is termed anatomically the inferior external triangle of the neck, a space bounded internally by the outer margin of the sterno-mastoid, inferiorly by the clavicle, whilst the posterior belly of the omo-hyoid, passing obliquely upwards and forwards, forms the superior and outer boundary of the space. Superficially, the area of this triangular space is covered in by the skin, superficial fascia, platysma, and deep fascia; whilst under the platysma we find the external jugular passing down to join the subclavian vein, and placed generally close to the outer edge of the sterno-mastoid, though not unfrequently it lies nearly over the middle of the space. Its position, however, can always be readily ascertained by pressure on the lower part of the neck, so as to make the vein distend. On dividing the deep fascia which binds down the omo-hyoid, we come upon a quantity of loose cellular tissue, containing numerous venous branches, such as the transversalis colli and others, running towards the subclavian vein. These venous branches generally coalesce to form a large trunk before joining the subclavian, and the large vein formed by their junction lies almost in front of, and in close apposition to, the subclavian artery. We have now arrived at the deeper plane of the triangle, on a level with the artery and the parts in immediate relation with it. The subclavian artery may be described at this level as situated in a deeper triangle—the boundaries of which are, internally, the outer margin of the scalenus anticus; externally, the scalenus posticus, the convergence of the scaleni forming the apex of the triangle, whilst the base and inferior boundary is formed by the first rib, on which the vessel rests. Contained within the limits of this deep triangle we find the nerves forming the brachial plexus superiorly, and inferiorly the subclavian artery. Crossing the area of the space near its apex is the transversalis colli or its branches, the posterior scapular and ascending cervical; lower down, the vein already mentioned, lying in front of the subclavian artery, passing down to join the subclavian vein, which is situated lower down towards the chest, and barely resting on the tendon of the

scalenus anticus, so as to leave a small space in which the costal attachment of the muscle is seen between the vein and artery. The supra-scapular artery and vein lie in close relation to the posterior surface of the clavicle.

If we now consider the relation of parts in reference to guides to the third part of the subclavian, we find, first, that very generally the outer edge of the sterno-mastoid corresponds to the outer edge of the scalenus anticus, with sufficient accuracy to form a guide to the position of that muscle. Second, that the outer edge of the scalenus is in relation at its upper part with the nerves of the brachial plexus, and at its lower part with the subclavian artery which lies immediately behind it, close to its insertion into the first rib. That attachment of the scalenus anticus to the first rib is marked by a well-defined osseous prominence or tubercle.

If we pass the finger from above downwards along the outer margin of the scalenus muscle to its attachment, we are guided to the tubercle on the first rib, and when the point of the finger touches the tubercle, the pulp of the finger must rest in contact with the subclavian artery, which lies in a shallow groove on the rib immediately behind and external to the tubercle. Thus we have a series of guides leading us from the surface to a fixed point in close relation to the artery, if it be in the normal position.

The position and relations of the middle and external portions of the subclavian arteries are remarkably constant, for although cases have been met with in which the artery ascended high in the neck, and then passed downwards and much further back than usual, or others in which the vessel perforated the anterior scalenus, and although there are also instances of the vein as well as the artery lying posterior to the scalenus anticus, or of the artery passing in front of the scalenus anticus, so as to be in close contact with the vein, yet such irregularities are very rare. In my own experience as an anatomist, out of many hundred bodies dissected in the practical rooms, where any abnormal distributions of the blood-vessels were carefully watched for, I have

only seen two instances of irregularity in the third portion of the subclavian, in both of which the artery passed in front of the scalenus, so as to be in apposition to the subclavian vein, and in both cases the irregularity was on the right side. The third part of the subclavian is usually described as not giving off any branches; but I believe it is almost as common to find the posterior scapular artery coming off from the subclavian close to the outer edge of the scalenus, as to find it arising from a common trunk with the ascending cervical from the thyroid axis, which is generally stated to be its usual mode of origin.

The anastomoses to which we chiefly trust for restoring the circulation after deligation of the external third of the subclavian are—*1st*, The supra-scapular, with the dorsal branches of the subscapular artery in the substance of the supra- and infra-spinatus and teres minor muscles. *2d*, The posterior scapular artery, with branches from the subscapular along the inferior costa and base of the scapula, and in the substance of the subscapular muscle. *3d*, Minute perforating branches from the internal mammary and intercostal arteries, inosculating with thoracic branches of the acromio-thoracic artery and other thoracic branches given off by the axillary. But, besides these more evident and direct anastomoses, the determination of blood on the collateral circulation which follows the obstruction of the subclavian artery brings into play vascular communications throughout all the surrounding tissues.

As ligature of the middle part of the subclavian has never been performed except as an extension of operations originally undertaken with the view of tying the external third, in which, owing to disease of that part of the vessel, it was found necessary to divide the scalenus to reach a healthy part of the artery, it is unnecessary to describe it as a special operation. But to consider the further procedure in such cases in connection with the operation for tying the third portion of the artery:—

The external third of the subclavian may be reached so as to apply a ligature, by means of a single incision parallel to and about eight lines above the clavicle, extending from the anterior

margin of the trapezius muscle to a point a few lines internal to the outer margin of the sterno-mastoid. The more important parts of the operation will, however, be much facilitated by making another incision about an inch and a half in length along the outer edge of the sterno-mastoid, so as to join the former incision nearly at a right angle. This method enables us, by dissecting or merely drawing back the angular flap marked out at the internal part of the wound, to expose more fully the parts immediately in relation to the vessels, so as to deal more readily with the artery, or to modify the operation, if necessary, by extending our incision inwards. There is no use in dissecting deeply at the outer part of the supra-clavicular incision, as we gain no room by doing so, and it is liable to lead us away from the subclavian artery and endanger the supra-scapular vessels. The skin, superficial fascia, and platysma myoides, should be divided by the first incision in the line indicated, care being taken to cut lightly through the textures over the course of the external jugular vein, so as to avoid wounding that vessel, which should be drawn aside, if necessary, by a blunt hook. The next step in the operation consists in dividing the deep fascia at the middle and inner part of the wound. In doing this there should be no dissection upwards or downwards; the fascia should be divided in the line of the incision directly from the surface towards the deeply-seated parts. When this is effected the angular flap of the textures can be drawn upwards and backwards, not forcibly, but merely held aside. At this stage the posterior belly of the omo-hyoid generally comes into view, and has by some been recommended as a guide; but it is not a safe guide to the artery, since it merely marks the depth or plane at which we have arrived. When the deep fascia is divided, the operator should pass his finger close to the outer edge of the sterno-mastoid muscle, directly backwards, to try if he can feel the outer margin of the anterior scalenus, or perhaps touch the artery itself. In general, however, the outline of the scalenus and the position of the vessel are rendered indistinct by a quantity of areolar tissue and lymphatic glands being

interposed, and the operator requires to break through this layer with his finger, or the cautious use of the point of the knife, to clear the scalenus more fully ; he then glides the fore-finger of his left hand from above downwards along the outer margin of the scalenus anticus, till the point of his finger touches the tubercle on the first rib, into which the muscle is inserted ; immediately above and behind this the subclavian is felt. By attending to this rule, the operator will avoid the risk of mistaking the large nerve which passes from under the edge of the scalenus immediately above the subclavian for that vessel. The next and most important step is to clear the vessel for passing the armed aneurism needle. In doing this we must keep in view the position of the venous branches crossing the course of the artery in front to join the subclavian vein, whilst higher up and deeper the pleura is in close relation to the deep surface of the vessel, and may be wounded in passing the needle. The former of these dangers is best avoided by the mode of incision I have recommended, which enables the operator to see the deep part of the wound, and, by using the point of finger and nail, gently to separate any loose tissue and push aside the veins before using the point of the knife, to clear the artery for ligature. The second danger—wound of the pleura—is best avoided by passing the needle under that part of the subclavian which rests upon the first rib, not higher up ; and this rule is also advantageous, should the posterior scapular artery arise, as it often does, from the third part of the subclavian close to the edge of the scalenus. The aneurism needle for this operation should be short in the point, and have a double curve to play over the clavicle, so as to allow the point to appear round the artery without elevating the vessel and unduly separating its connections. In accordance with the general rule, the point of the needle should be passed from the position of the subclavian vein upwards and outwards ; but in many cases it is difficult to effect this, owing to elevation of the shoulder raising the clavicle so as greatly to deepen the subclavian space. In such cases the point of the finger may be made to guard the vein whilst the needle is passed from above downwards.

Should the third portion of the subclavian be found in a doubtful condition for the safe application of a ligature, the incisions must be extended so as to expose the middle portion. For this purpose the incision is carried through the clavicular attachment of the sterno-mastoid and superimposed tissues. This procedure, added to the former incisions, exposes the scalenus anticus, with the phrenic nerve crossing it obliquely from above downwards and inwards, and lower down, and more internal, the confluence of the subclavian and internal jugular veins. Two important arterial branches, the transversalis colli and supra-scapular, cross the scalenus more superficially than the parts mentioned, and require to be avoided in dissecting through the cellular tissue lying between the sterno-mastoid and the more deeply seated parts. Even in tying the third portion of the subclavian I have seen one of these vessels wounded, and give rise to serious embarrassment to the surgeon and danger to the patient. And we must also remember that these are two of the most directly and important anastomosing branches for re-establishing the circulation in the upper extremity after deligation of the subclavian. The special points of danger, however, in this extension of our incision to expose the part of the artery covered by the scalenus, is the risk of injuring the phrenic nerve lying upon the muscle to be divided, and injury of the pleura, which is here in close proximity to the vessel to be tied. The former danger is met by drawing the nerve gently aside by means of a narrow copper spatula, and then carefully dividing the scalenus, so as to expose the subclavian, whilst the wound of the pleura is guarded against by keeping the point and concave surface of the aneurism needle in close contact with the coats of the artery in passing round it.

When all oozing of venous blood has ceased, the wound is closed by points of suture, and the patient placed in bed, with the arm supported but not much bent. The patient should be laid upon the side operated on, so that serous discharge or venous oozing, if there be any, may escape by the outer angle of the wound. One of the secondary risks of ligature of the subclavian, apart from the risk of secondary hæmorrhage, is the formation of

pus at the deep part of the wound from the accumulation of discharges which have lodged there, and as there is great difficulty in placing the patient so as to obtain a dependent aperture of escape, the pus is apt to burrow towards the pleura, and even ulcerate into the pleural cavity. To obviate this risk, as well as that of secondary hæmorrhage, there should be the least possible disturbance or fingering of parts during the operation ; all oozing of blood, however slight, should be arrested by cold or some other plan before the wound is closed, and attention given that no accumulation be allowed to take place.

LIGATURE OF THE AXILLARY ARTERY used to be performed for axillary aneurism, but the operation has now been given up. I should only perform it in Brasdor's operation for tying the artery on the distal side of the aneurism, in the case of subclavian aneurism, or as a preliminary to amputation of the arm for such ; I should be inclined to tie the upper part of the axillary, so as to prevent bleeding from the enlarged muscular branches, and also because it would avoid having a great number of collateral branches coming off between the aneurism and the ligature. The operation is a much more difficult one than tying the third part of the subclavian artery. Some authorities recommend cutting down between the two portions of the pectoral muscle, and cutting through the coraco-clavicular fascia, but in doing this we come upon the vein and not the artery ; and secondly, we have a very constricted and narrow opening with a very deep wound. Others, again, advise to cut between the clavicular fibres of the deltoid and the clavicular fibres of the pectoralis major, but this is also objectionable. The best plan is to cut across the fibres of the pectoralis major and some fibres of the deltoid, so as fully to expose the deeper parts, and then through the coraco-clavicular fascia. Care must be taken not to wound the axillary vein, which is superficial and internal to the artery. The axillary nerves lie to the outside of the artery, and are not much in the way. This operation, however, merely enables us to get at the vessel just at its commencement, and nearly the

same point can be reached much more readily by the operation for ligature of the third part of the subclavian, without approaching so nearly the origin of the large acromio-thoracic branch.

The middle, or second portion, of the axillary artery is never tied, in cases of aneurism, from the number of collateral branches coming off from it. When wounded it may require ligature, which must be effected by enlarging the external wound.

The third portion of the axillary artery may be tied quite as easily as the brachial artery. In this case, our best guide is the inner edge of the coraco-brachialis muscle. If we trust to the feeling of pulsation in the artery as our guide to its position, we are very apt to be misled. After dividing the skin and fascia, the first thing we should look for is the margin or edge of the coraco-brachialis. Immediately internal to it the median and internal cutaneous nerves come into view, and behind and between them is the artery. The nerves are separated slightly, the arm being relaxed, and the needle is then easily passed round the artery.*

The BRACHIAL ARTERY may require to be tied in cases of circumscribed false aneurism, or circumscribed varicose aneurism ; and it has in such cases been tied in the middle of the arm with success ; but still I think the best plan of treating a false aneurism is to cut into it, and tie the vessel above and below, so as to prevent all retrograde circulation. The cases in which the brachial artery requires to be tied are those in which either the brachial itself or the palmar arch has been wounded. In the latter case, the general principle of securing the vessel at the wounded point in the first instance should be followed out ; but if hæmorrhage result after doing this, and if the parts be in such a state that we cannot apply pressure directly on them, then we must tie either the radial and ulnar arteries, or the brachial, and apply some moderate compression on the wounded point. In wounds of the palmar arch we should enlarge the opening in the skin and fascia at first, and apply direct compression on the arch, with a bandage and pad of lint along the course of the

* See Clinical Cases, page 594.

brachial, so as to command the circulation. In most cases these means will succeed ; but when they prove inefficient, or when the coats of the artery slough, then we must tie the brachial in the middle of the arm, which is safer than tying both radial and ulnar arteries, from the free anastomoses of these vessels, and we must also apply a moderate amount of compression on the wounded point.

Operation.—The brachial artery is very easily reached, and can generally be felt in the living subject ; but we should not trust to the feeling of pulsation only, as we are apt to be misled. The best guide to the position of the artery is the inner margin of the biceps, the arm being extended. The median nerve passes obliquely from without inwards and downwards, crossing the vessels, so that it lies upon the artery about the middle of the arm. It must be gently drawn aside, the vessel cleared from the venæ comites, and the needle then passed below the artery. When we cut down on the artery at the middle of the arm, if we find a large vessel, without seeing the nerve, it is probable that the artery has divided into its two terminal branches, higher up than usual, and the other branch should be looked for in its normal relation to the median nerve.

The brachial artery may require to be tied at the bend of the elbow in cases of false aneurism. A tourniquet is applied at the upper part of the arm, so as to prevent all bleeding ; and an incision is made into the sac of the aneurism, and its contents turned out, and the vessel tied above and below the wounded point—as already described at page 559 (Plate xxv. Figs. 1 and 2).

The ARTERIES OF THE FOREARM seldom require to be tied except for the immediate or secondary effects of wounds. In such cases the wound should always form part of our incision, as, otherwise, the wounded part of the vessel may not be reached except by unnecessary dissection. But whilst this will modify the procedure for ligature of the vessels in different cases, I think it right to indicate some general rules for the performance of ligature of the radial and ulnar arteries.

To perform the ligature of the RADIAL ARTERY above the middle of the forearm, the limb being extended and resting upon its dorsal surface, the surgeon, placed to the outside, makes an incision at least two inches in length, and parallel with the internal edge of the supinator radii longus muscle. In order to find the edge of that muscle, it is sufficient to apply the fingers of the right hand upon the radial artery, as if to feel the pulse, and trace it towards the bend of the arm by following the furrow, which is bounded externally by the supinator radii longus, and internally by the pronator radii teres and palmaris longus muscles.

In this manner the intermuscular space which lodges the vessel is easily found. If the incision, however, is not made perfectly to correspond with this line, it will not be of much consequence ; to remedy this fault it is sufficient to divide a few muscular fibres to arrive at the artery, which is always found in the first intermuscular space we arrive at in tracing from the external to the internal side of the forearm. The mobility of the skin upon the aponeurosis renders the examination of this space very easy. The skin alone having been cut, the surgeon searches, as we have said above, for the internal edge of the supinator radii longus muscle, and dividing the aponeurosis parallel with that muscle, and slightly raising it, perceives the vessel placed immediately below. But before proceeding to insulate, in order to tie the artery, he must open the aponeurotic covering of the supinator radii longus muscle. This layer divided, the operation is easily terminated.

At the inferior part of the forearm the muscles which we have seen to surround, by their fleshy bodies, the upper portion of the radial artery, being only represented by their respective tendons, a large space is left between them, so that nothing can be easier than the ligature of the artery in this region. This artery is accompanied, as in its superior parts, by two veins, one internal and the other external to it, and covered by the aponeurosis and the skin.

To perform this operation, an incision corresponding with the

middle of the space which separates the tendons of the supinator radii longus and the flexor carpi radialis muscles must be made to divide the skin, and the aponeurosis must be divided to the same extent as the skin. This done, the artery, with its accompanying veins, is seen ; the insulation must be carefully effected, so as not to wound the veins, and the ligature applied. It may be mentioned, however, that the rupture of a single vein, or its ligature, if it be small, does not occasion any real danger.

In order to tie the ULNAR ARTERY at its upper part, the forearm must be extended and laid upon its dorsal surface. The surgeon, placed either to the inner or outer side of the limb, searches for the tendon of the flexor carpi ulnaris, which is readily known at its inferior part by feeling for the pisiform bone to which it is attached. This done, he must trace from below upward the furrow which separates the tendon from that of the flexor digitorum sublimis, and thus proceeding towards the internal condyle of the humerus, the direction is indicated in which the incision must be made. The surgeon, after having determined the edge of the flexor carpi ulnaris, makes an incision of the skin with the bistoury, parallel to that edge ; he then searches for the first intermuscular space which can be found proceeding from the ulnar to the radial side of the arm. If the skin be very movable, this is easily distinguished, so that, if the first incision be badly directed, it can be corrected by means of the mobility of the skin. We could not, however, avail ourselves of this resource had the skin, aponeurosis, and a certain portion of the muscular fibre, been cut at the same time.

Having found the intermuscular line which is formed by the contact of the flexor carpi ulnaris, and of the flexor digitorum sublimis, the aponeurosis which unites them must be divided, and those muscles forcibly separated from each other. In order to facilitate the opening of the wound, it is recommended that the hand be slightly flexed upon the forearm, and the forearm upon the arm. In following the external surface of the flexor carpi ulnaris from within outward, we see upon the same plane first the ulnar nerve, the internal vein, and then the artery with

the other vein to its outside. At the superior angle of the wound the nerve is separated from these vessels by a space which diminishes towards the inferior angle, until they become in immediate contact. These vessels having been exposed, the artery must be insulated and tied.

Ligature of the ulnar artery at the inferior part of the forearm becomes much easier. The two muscles, which, being in apposition superiorly, cover the artery and its accompanying veins, are in this region separated from each other for the space of four or five lines, so that it is extremely easy to arrive at the artery. To accomplish this an incision of the skin must be made parallel to the tendon of the flexor carpi ulnaris, but two or three lines external to it ; the position of the pisiform bone, into which it is inserted, forms a sure guide to the tendon. Having divided the skin, the last-named tendon must be found, and the aponeurosis divided to the same extent as the incision of the skin. The opening having been made, the tendon of the flexor carpi ulnaris, the nerve, and then the vessels, are exposed to view ; the artery is placed between its two veins, it is easily insulated, and its ligature accomplished.

LECTURE LXXVII.

Surgical Anatomy of the Iliac Arteries—Steps of the Operation for tying them
—Modes in which the Circulation is subsequently re-established—Direct
Ligature of the Iliac Arteries for Aneurism.

THE abdominal aorta, on reaching the lower part of the lumbar vertebræ, divides into its terminal branches, the two common iliac arteries, and its more direct continuation, the small artery known as the middle sacral. Its two great lateral branches, the common iliac arteries, descend obliquely outwards and somewhat forwards, diverging until they arrive in front of the sacro-iliac synchondrosis, at which point each common iliac again subdivides into the internal iliac or hypogastric artery and the external iliac.

The internal iliac artery passes abruptly downwards from the point of division in front of the sacro-iliac synchondrosis, and, on arriving at the level of the ischiatic notch, subdivides into numerous branches to the various pelvic viscera, and others which pass through the obturator foramen and ischiatic notch to be distributed outside the pelvis. The external iliac artery, from its place of origin, passes downwards and slightly outwards until it reaches a point nearly midway between the anterior superior spine of the ilium and the body of the pubis corresponding to the ilio-pectineal eminence ; it then passes beneath Poupart's ligament, and receives the name of common femoral. The relations of the arteries whose general course I have indicated may be stated as follows :—Each common iliac is about $2\frac{1}{2}$ inches long, and, in its descent, rests on the lateral aspect of the bodies of the inferior lumbar vertebræ, and is somewhat in relation laterally to the inner part of the psoas muscle, to which it approaches more closely at its bifurcation. On the right side the common

iliac trunk rests, in its lower half, upon the junction of the right and left common iliac veins, where they are about to form the inferior vena cava, or, more properly speaking, rests on the commencement of the cava. On the left side the common iliac vein lies completely internal to the corresponding artery. In front these vessels are covered by a layer of the peritoneum, very loosely connected with them and easily pushed aside. Still more in front we have the abdominal viscera and inferior mesenteric artery, and the anterior abdominal parietes, which have a variable relation to the vessels, in regard to distance, according to the development or distension of the abdomen and the state of the viscera. The ureter occasionally crosses the common iliac trunk ; more generally, however, this duct crosses obliquely immediately below the bifurcation, or just at that point. In either case the ureter is very loosely connected with the parts over which it passes, and when the peritoneum is pushed inwards from off the surface of the vessels the duct follows the peritoneum. The internal iliac artery in its course rests posteriorly on the nerve connecting the lumbar and sacral plexus, and on the nerves forming the latter plexus as they pass outward. The corresponding veins lie to the inner side of the artery, towards the upper part, where the surgeon should apply his ligature, for the internal iliac trunk is very short and variable in its length. The numerous veins which coalesce to form the internal vein have also very variable relations, some passing behind and some crossing it in front, and require to be carefully avoided in clearing the artery for ligature. The ureter lies in front, attached to the posterior surface of the layer of peritoneum which passes from the lumbar region and iliac fossa, and covers the fore part of the internal iliac artery.

The external iliac artery rests throughout its whole course upon the inner aspect of the psoas muscle, and more immediately upon the aponeurotic fascia, covering the muscles of the iliac fossa. The connective tissue here is very fine and loose, so that the vessel is easily separated from its posterior connections. The external iliac vein lies in close contact with the internal side of

the artery, and in front a branch of the ilio-lumbar nerve lies upon it; further removed, and gradually passing towards the parietes, the spermatic artery and veins also pass down in front. In some cases, lymphatic glands lie in close relation to the vein at the lower part. The fold of peritoneum reflected from the anterior abdominal parietes upon the iliac fossa, covers the fore-part of the vessels, but at a short distance above Poupart's ligament, corresponding to the point of reflection, the peritoneum may be said to be separated by an interval from the artery and vein; and throughout the whole of the iliac fossa, and immediately above Poupart's ligament, the peritoneum is so loosely connected as to be easily separable from the vessels; whilst higher up, in the lateral region of the anterior abdominal parietes, the membrane is very closely connected with the fascia transversalis, and attempts to separate it from the parietes there would almost certainly be attended with laceration or puncture. On arriving close to Poupart's ligament, the external iliac gives off two branches, the deep epigastric and circumflex ilii arteries. The former courses obliquely upwards and inwards, the latter outwards in the direction of the spine of the ilium. The vas deferens, as it passes from without inwards, crosses the course of the external iliac vessels, more especially that of the vein, and, together with spermatic vessels forming the spermatic cord, lies in pretty close relation to the anterior aspect of the vessels near the lowest part of their course. Lastly, in front we have the intestines projecting into the peritoneal sac and the anterior abdominal parietes, as in the case of the other iliac arteries. In speaking of the general course of the external iliac artery, I have described its normal position on the anterior and inner aspect of the psoas throughout its whole length; but in old persons, or in cases in which an aneurism or other cause of obstruction to its circulation is present, the artery, owing to the feeble cellular connections which it has with the fascia on which it rests, forms numerous flexures, or one or two large curves, so that a large part of the vessel often dips into the true pelvis before it ascends again to gain the pubis. This need give rise to little or no difficulty in

operating for ligature of the vessel, because at its lower part it is always found on the pubis ; so that, by tracing it from that point upwards, or from its bifurcation downwards, its position in any case can be readily ascertained. But it is well to recollect how easily it is displaced, in relation to diagnosis of iliac aneurism, and in deciding whether the external or common iliac artery should be tied, for in some cases of aneurism low down on the external iliac, the tumour displaces the upper part of the artery, curving it on itself, and thus might mislead us as to the extent of healthy artery between the aneurism and the common iliac.

Operation.—From the anatomical disposition of the parts as described, it results, that to expose and tie any of the iliac arteries, the skin, superficial fascia, the aponeurosis of the external oblique and the internal oblique and transversalis muscles, together with the transversalis fascia, must be divided, whilst the peritoneum must be carefully separated from the iliac fossa, and pushed aside.

In performing the operation, the patient should be laid upon his back, the pelvis a little inclined towards the healthy side, so that the floating intestines may fall into the pelvis and cause less projection of the peritoneum into the wound. The operator, having ascertained the position of the spine of the pubis, commences his incision about two inches external to that point, and about eight lines above the crural arch, and carries it obliquely upwards through the skin and superficial fascia for about three or four inches, so that it shall terminate above, about ten lines internal to the anterior superior spinous process. It is evident that by this line of incision we cannot come directly upon the artery, but then we weaken the abdominal parietes less than by any other line of incision, and we reach a part where we can most readily push aside the peritoneum without risk. Any branches of arteries or veins which bleed should be tied, and then the aponeurosis of the external oblique muscle divided to the same extent as the incision of the integuments. The fibres of the internal oblique and transversalis muscles are next carefully

divided, to the extent of two inches, at the lower outer part of the wound. The fascia transversalis is thus exposed, and must be divided with great caution lest we wound the peritoneum. Perhaps the best method of doing this is to raise a small portion in the dissecting forceps, and apply the edge of the knife, held horizontally, so as to cut out a small portion. This enables the surgeon gently to separate the edges of the opening in the fascia, and enlarge the opening with a probe-pointed bistoury, the edge of the bistoury being directed outwards. By the small opening thus made, the operator enters his forefinger and carefully separates the peritoneum from the transversalis fascia muscle, in the line of his incision, and then slits up the internal oblique and transversalis muscles to such an extent as may be necessary to enable him to reach the vessel. He next pushes the peritoneum aside and inwards from the iliac fossa, so as to expose the artery. An assistant, whose hands have been previously dipped in warm water, holds aside the sac of the peritoneum and contained viscera, so as to keep them out of the way of the operator, but this must be done with great care. If necessary, the outer margin of the wound may be held aside by a curved metallic spatula, but in general the vessels are readily seen. The fine cellular sheath should be opened over the fore part of the artery, and the circumference of the vessel cleared, so far as is required to pass the armed aneurism needle. The point of the needle should be passed from within outwards, so as to avoid injuring the vein. When the point appears at the outer side of the artery, the ligature is seized with the dissecting forceps, the aneurism needle withdrawn, and the vessel tied. Before closing the wound all clots should be removed, and any bleeding points secured. In closing the incision, the sutures should be placed deeply, to prevent the risk of protrusion, and to obtain union of the deep as well as of the superficial parts of the incision, and thus obviate weakness of the abdominal parietes. In passing the sutures with this view care must of course be taken to avoid puncture of the peritoneum with the needle. When the operation is completed, a large flat compress of lint is placed over

the wound, and kept in position by broad strips of adhesive plaster, so as to support the abdominal wall in the vicinity of the incision. When removed to bed, the patient should be placed on the sound side, to remove, as far as possible, all pressure from the weakened part, and an opiate given to procure rest and diminish the peristaltic movements of the intestines.

The operative procedure for reaching either the internal or common iliac arteries, is, up to a certain point, precisely similar to that just described ; but when the surgeon has to some extent separated the peritoneum from the iliac fossa, he continues to separate it further up from the interior of the transversalis muscle and fascia, pushing it gently inwards, and then, with a probe-pointed bistoury introduced flat on his finger, he turns the edge upwards and extends the incision to the degree required to enable him to reach the vessel which he wishes to tie. He must, however, remember that the closer attachment of the parietal peritoneum, and the greater bulging of that membrane high up in the abdomen, render it more liable to injury, and he must also keep in mind his proximity to the ureter and spermatic vessels.

The method of tying the external iliac by a nearly transverse incision, about six or eight lines above Poupart's ligament, as practised by Sir Astley Cooper, enables the surgeon to reach the vessel easily enough at its lower part in the case of a femoral aneurism which does not bulge upwards. But the vessel is exposed too near its collateral branches, the epigastric and circumflex ilii, and the spermatic cord is in greater danger. The principal objection, however, is, that we cannot tie the vessel higher up, should that be found necessary, without having recourse to a new line of incision such as that which I have described, so that the oblique ascending incision, Abernethy's method as it is sometimes termed, is that generally, and I think deservedly, preferred.

The arterial anastomoses which maintain and ultimately re-establish the circulation beyond the point of deligation in the case of ligature of the external iliac artery, are very numerous,

for, as I have already shown, every minute twig enlarges at first. But the larger and more direct inosculations, are—1. The internal mammary from above, with the deep epigastric from below, the deligated part. 2. The ilio-lumbar and lumbar branches of the aorta, with the deep circumflex ilii of the external iliac. 3. The extra-pelvic branches of the internal iliac, with branches of the femoral—as, the scrotal branches of the deep pudic, with those of the superficial or inguino-pudic branch of the common femoral, and the gluteal ischiatic and obturator, with the branches of the internal and external circumflex and perforating arteries from the deep femoral.

When the common or internal iliac arteries have been tied, the free communications between the branches of the two internal iliacs, and of both with the middle sacral, together with the anastomoses just mentioned, speedily re-establish the circulation below the ligature, and the maintenance of the distal circulation is amply provided for.

When speaking of inguinal aneurisms, I referred to the revival of the old operation for aneurism, by opening the sac, turning out the contents, and then tying the vessel on either side of the sac. It is scarcely possible to lay down rules for the steps of such operations. The plan hitherto adopted has been to command the circulation through the abdominal aorta, by means of the abdominal tourniquet, and then to make a limited incision through the anterior parietes into the sac, to enable the operator to introduce his forefinger and break up the adherent coagula; then rapidly to enlarge this opening upwards and downwards, and turn out the coagula, and so expose the interior of the sac, and recognise the opening of the artery into it above and below, and clear the vessel and tie it at these points.

From what I have seen of such operations, it always appeared to me that very great difficulty occurred in recognising the orifices of the artery in the sac, and this is what we might expect from the way in which true aneurism, either saccular or fusiform, arises. Again, as I have pointed out when speaking

of the loose connections of the external iliac artery, an aneurism of the lower part of that vessel, by enlarging, may push up or aside the upper part of the vessel, and lead the surgeon to suppose it necessary to tie the common iliac. I should, if performing such an operation, make my incisions through the abdominal parietes where these were not adherent to the sac, by dividing them upwards and outwards towards the ilium and flank. Then, passing the finger gently downwards between the sac and the parietes, as far as that could be done without force, I should divide the abdominal wall in that direction. The peritoneum in such cases is usually pushed upwards and inwards by the tumour, and is so far removed from injury. Having enlarged the opening of the abdominal wall as far as could be done without injury to the sac, I should then feel with my finger for the artery higher up, so that an assistant might command it by direct compression, or I should clear it as closely down to the sac as possible, and place a ligature under it, and entrust it to the assistant. Then, returning to the lower part of the incision, I should by careful dissection divide the crural arch and fascia lata in the groin below the tumour, to command the circulation from below, and if possible trace and expose the artery close up to the sac, and let an assistant compress it directly. All being thus prepared, I should make a small incision into the sac, break up the coagula, enlarge the opening, and turn them out. The circulation being commanded both above and below the aneurism, I should then tie the upper ligature which had been placed under the vessel, and entrusted to an assistant at the earlier stage of the operation. If the lower portion of the artery admitted of ligature above the origin of the epigastric and circumflex ilii, I should tie it there, but if not, then I should clear the common femoral where it had been exposed, and pass a ligature below it. Any coagula which remain, or portions of the sac which can be removed without risk to the peritoneum, should be cut away, so as to diminish the risk of extensive suppuration, and the wound then closed.

LECTURE LXXVIII.

Ligature of the Femoral Artery : in Lower Part of Scarpa's Triangle ; in Hunter's Canal—Anastomoses by which the Circulation is restored—Ligature of the Anterior Tibial Artery : of the Posterior Tibial Artery.

FROM the point where the external iliac artery emerges from below Poupart's ligament into the region of the thigh, until it enters the popliteal space, by passing through the opening in the tendon of the adductor magnus, the vessel receives the name of femoral. The general course of the FEMORAL ARTERY, if we include the commencement of the popliteal, is indicated by a prolonged and gently spiral line, which, in relation to the femur, descends from without inwards and backwards, then more directly downwards, and lastly, outwards and backwards, winding round so as to gain the posterior aspect of the femur in the popliteal space. The common femoral artery, the direct continuation of the external iliac, is always a very short trunk, not exceeding an inch and a half in length ; and, after passing from off the pubis, descends superficially, being merely covered by the integuments, superficial fascia, and the iliac portion of the fascia lata, and a variable quantity of fat and lymphatic glands lying on the fascia over the vessel. In this part of its course the vessel rests upon the lower part of the psoas, having the mass of the iliacus muscle, which is here united with the psoas, in relation to its outer side. The anterior crural nerve is in this region deeply seated between the iliacus and psoas muscles, but soon becomes superficial, and lies about quarter of an inch, or rather more, to the outer side of the artery. The common femoral vein lies close to the inner side of the artery, and rests on the pectineus, a quantity of cellular tissue intervening. The common femoral gives off superficial branches—the superficial epigastric, superficial circumflex ilii, and superficial pudic. It then sends off the great pro-

funda or deep femoral, which gives off numerous branches to the muscles and other textures of the thigh. The femoral artery continues to descend in the course already described, till it reaches the popliteal space. As the femoral artery descends in the thigh, it gradually passes more deeply, and its relations become more complicated; the vein, which above lies to its inner side, gradually comes to be placed behind it, so that the artery rests upon the vein. Both these vessels, together with the great saphenus branch from the anterior crural nerve, are inclosed in a common sheath, which lies in a canal bounded internally by the adductors, and externally by the vastus internus, where these muscles converge near their attachments to the femur. A layer of dense fascia, stretching from the vastus to the adductor muscles, passes in front of the vessels and closes the canal anteriorly. This fascia becomes aponeurotic towards the middle and lower parts of the thigh, and the canal, for two or three inches above the point where the vessels pass out of it into the popliteal space, is very narrow and contracted. In the middle and lower third of Scarpa's triangle, the femoral continues to be covered only by the skin and fasciæ; but gradually the sartorius muscle, which descends obliquely inwards from the superior spine of the ilium, comes into relation with the vessel lying, at first, close to its outer side, on a plane superficial to it; next, slightly overlapping; and at last lying upon and covering the artery throughout the remainder of its course in the femoral region. The point of election for tying the femoral is at the apex of Scarpa's triangle, just where the sartorius begins to overlap the vessels, and hence the inner edge of this muscle forms our guide to reach the artery at this point; whilst, if we require to tie it lower down in Hunter's canal, the outer edge of the sartorius again serves as our guide to secure it. Under the fascia, beneath the sartorius, and in front of the sheath, there ~~are~~ *are is* sometimes a quantity of fat, and some nervous filaments from the anterior crural, which cross the vessels obliquely. From the point where the femoral artery gives off the profunda, with

the exception of a few small muscular twigs, no large collateral branch arises from it, until, at its lowest part; just before it passes through the adductor into the popliteal space it gives origin to the *anastomotica magna*.

*Operation.**—I have already said that the point of election for tying the femoral artery is towards the lower part of Scarpa's triangle, immediately above its apex, where the sartorius and adductor longus muscles approach each other. Here the sheath of the vessels is comparatively superficial, and the relative position of the sartorius gives us an excellent guide to the artery. The surgeon having ascertained the course of the sartorius, and also the position of the saphena vein and the superficial veins which sometimes join that vessel in this region, should make an incision about three inches long, beginning an inch or so below the apex of Scarpa's triangle, and continuing it upwards to the requisite extent along the course of the artery. This line will correspond to the inner margin of the sartorius. Higher up the muscle lies more obliquely outwards, less in relation with the artery. In operating on the right limb, the surgeon cuts from above downwards in the same line and to the same extent. This first incision should merely pass through the skin, superficial fascia, and fat, so as to expose the fascia lata, shining through which the sartorius muscle is generally seen. The fascia is next carefully divided along the inner edge of the sartorius, at the lower part of the wound, and slit up in the direction and to the full extent of the superficial wound. This exposes the fibres of the sartorius and the fascia covering the sheath of the vessels, under which there is often a quantity of fat. The operator should now trace from above downwards with his finger, so as to feel the pulsation, and so re-assure himself of the exact position of the artery. Without any further dissection, the edge of the sartorius is gently held aside at the part where it begins to overlap the sheath. The fascia is opened immediately over the artery by pinching up a portion of it with the dissecting forceps, and applying the edge of the

* Plate xxix. Figs. 2 and 3.

Fig 1

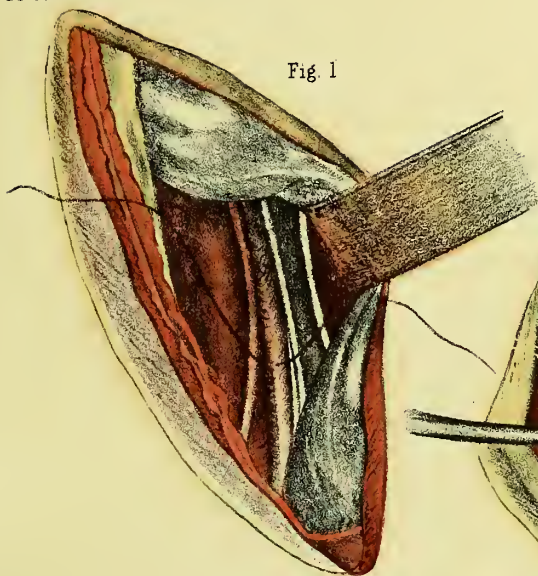


Fig 4

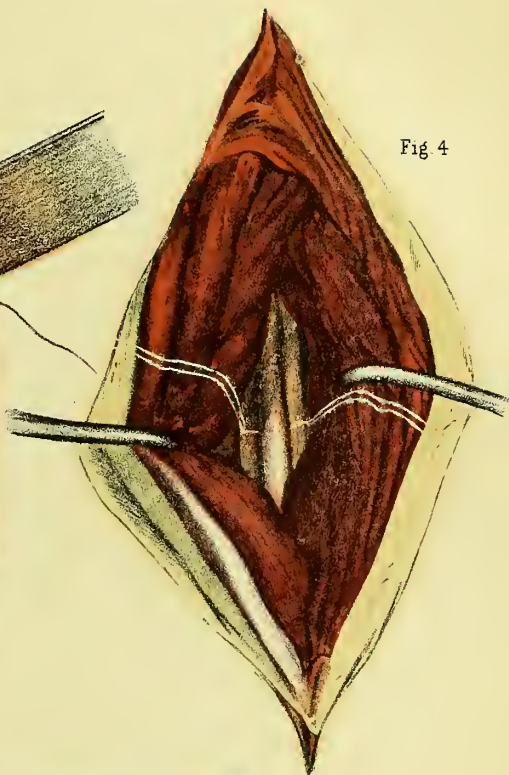


Fig 2

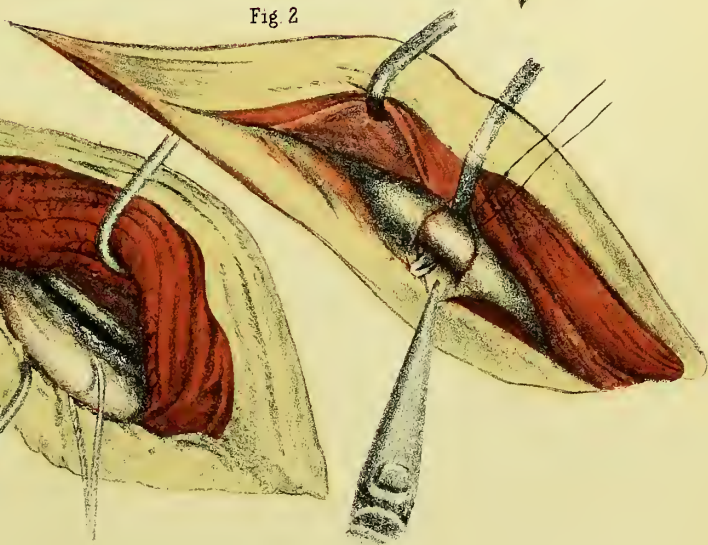
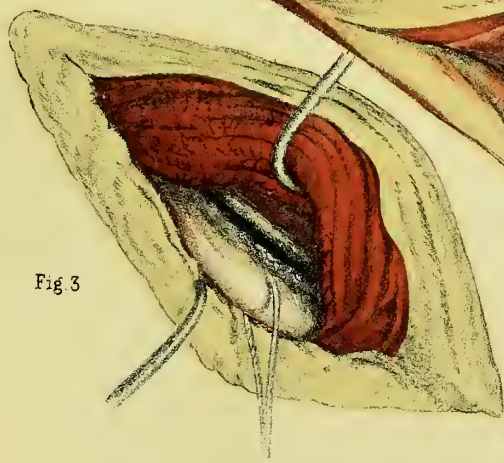


Fig 3



knife horizontally so as to cut out a small piece. The opening so made is enlarged to the extent of an inch and a half or two inches. When this is done, the inexperienced operator might think that all he had to do was to pass the ligature, for the vessel comes into view full and rounded. But the most important steps of the operation yet remain to be performed—namely, opening the proper sheath of the vessels, and insulating the artery, for passing the ligature round it. The surgeon should raise a portion of the sheath, and open it in the same manner as he opened the fascia; and when he has, with the point of his knife, sufficiently cleared the sheath from the artery on its inner aspect, he seizes the margin so cleared with a pair of catch-artery forceps, and lets them rest on the inside of the limb, so as to fix the opening in the sheath (Fig. 2, Plate xxix.) Then, laying hold of the external edge of the opening in the sheath with the dissecting-forceps, he clears the artery from it in the same way and to the same extent as on its inner aspect, so that the armed aneurism needle may be passed without any force or undue disturbance of parts. Perhaps there is no artery in the deligation of which greater care is requisite in opening the sheath and clearing the artery than the femoral. The vein lies completely behind the artery at the point where it is usually tied, always closely, often firmly, connected to it, much more so than is the case in other vessels; and if the artery be not properly insulated, any attempt to force the needle between the artery and vein is almost certain to wound the latter. The artery should be fairly cleared for about two lines round its circumference, so as to allow the needle to be passed easily. The opening of the sheath in front is of course larger, a quarter of an inch or so, to enable the surgeon to see the parts. The aneurism needle is generally directed to be passed from within outwards; but as the vein lies quite behind, it is immaterial from which side we pass it, if we only attend to the clearing of the artery already spoken of. Should the needle, by any accident, puncture the vein, it should be at once withdrawn and passed more carefully. If the thread be tied, and allowed to remain, the

venous bleeding will be arrested, owing to the diminished arterial supply ; but the ligature so left will keep up irritation, and lead to phlebitis, obstruction of the vein, and gangrene. The accident is a very dangerous one ; but we give the patient the best chance by withdrawing the needle and ligature, and passing the needle again so as to avoid the injured vein. By doing this at once, the puncture in the vein may heal, and no bad consequences follow. When the needle is so far passed round the artery that its eye and the ligature can be seen, the surgeon should seize the loop of the ligature with his dissecting-forceps, and then withdraw the aneurism needle ; this avoids all unnecessary traction on the vessel or destruction of its vital connections. The ligature is then to be firmly tied with the reef-knot, and both ends twisted so as to form one cord, which is brought out exactly opposite the point of deligation. The wound is then washed out with a little cold water, and its margins closed by a few points of suture. Two narrow flat pads of lint are placed, one on either side of the incision, and retained by strips of plaster, to keep the superficial in apposition with the deeper textures. The limb below the knee should be enclosed in a sheet of cotton wadding, and laid on its outer side, slightly flexed, on a water-pillow, moderately filled with barely tepid water. No external heat should be applied to the limb or foot.

Ligature of the femoral lower down, in Hunter's canal, is only performed in exceptional cases. I have referred formerly to a case of varicose aneurism, where I tied the femoral both in Scarpa's triangle and Hunter's canal, so as to include the aneurism between the deligated points ; and the details of the operation are given in the clinical cases illustrative of the treatment of aneurism. But the cases where ligature of the femoral in Hunter's canal is required are very rare. When, however, the surgeon finds it necessary to perform such an operation, it may be accomplished in the following manner. The surgeon, having ascertained the position and breadth of the sartorius muscle, as in the higher operation, makes an incision fully three

inches in length along its *outer* margin. This incision should divide the integuments, superficial fascia, and fat. The operator next incises the fascia lata to the same extent, so as fully to expose the edge of the sartorius. If the fascia be very strong and aponeurotic, it is advisable to divide the fascia across the line of the sartorius by a small transverse incision about the middle of the longitudinal one, to allow of the muscle being drawn fully to the inner side, as, at the part where the artery is to be tied, the sartorius does not merely overlap, but completely covers the aponeurotic canal enclosing the vessels. When the sartorius has been separated and drawn inwards, the strong tendinous aponeurosis forming the anterior wall of Hunter's canal is exposed. This should be carefully opened with the point of the knife, and then slit open more fully with a probe-pointed bistoury, to avoid all risk, as the aponeurosis is very closely applied upon the contained vessels. The proper sheath of the vessels is then opened, and the armed aneurism needle passed with the same precautions as in the higher operation, and the treatment of the wound and limb is similar in both cases.

When, from any cause, as in my case of traumatic varicose aneurism formerly alluded to, the sartorius is adherent, so that it cannot be fully drawn aside, I would advise its complete division to facilitate the deligation of the artery. The adhesions above and below would prevent the divided ends retracting very far from each other, and union ultimately would take place with little, if any, loss of muscular power, whilst we avoid unnecessary manipulation in the vicinity of the vessels.

In tying the femoral by the direct method in a case of false aneurism, or for wounds, the incision should be free, to enable the surgeon to see the parts distinctly, so as to avoid injury of the vein. The artery is commanded above by the tourniquet, and the sac of the false aneurism opened in accordance with the general principles laid down in Lecture lxxi., pages 558-59. In cases of circumscribed false femoral aneurism, I have already indicated my reasons for preferring ligature of the femoral on the Hunterian principle in Scarpa's triangle.

The principal anastomoses which restore the circulation in the leg and foot after ligature of the femoral artery, are : 1. The long descending branches of the external circumflex artery inosculating with the superior external articular of the popliteal, and with other small branches of the popliteal at the outside and front of the knee. 2. The obturator artery and descending branches from the internal circumflex, with muscular branches, and with recurrent branches from the *anastomotica magna* below. 3. The arterial chain of communication formed by the three perforating arteries inosculating with each other, and superiorly with the gluteal, sciatic, and transverse branches of the external circumflex, whilst inferiorly they communicate with the articular and other branches of the popliteal artery. 4. The anastomoses of the terminal branches of the profunda with the *anastomotica magna*, the superior articular, and other branches from the popliteal. The tibial recurrent and the inosculations of the *anastomotica magna* with the articular arteries, assist, especially in cases where, as in popliteal aneurism, some of the articular arteries are obstructed at their origin from the popliteal.

Ligature of the arteries of the leg is seldom required, except in cases of wounds, or of false aneurism resulting from wounds, and as the wound should in general form part of our incision in such lesions, this will modify the operative procedure in different cases. Nevertheless, as in the arteries of the forearm, the line of incision should come as directly as possible upon the wounded vessel, and be determined by certain anatomical guides. I shall therefore describe very briefly the operations for exposing and tying these arteries.

The popliteal artery, almost immediately after it has passed beyond the lower margin of the popliteus muscle, divides into the anterior and posterior tibial arteries. The ANTERIOR TIBIAL ARTERY passes directly forwards through the interosseous membrane, and then continues to pass downwards, lying upon the anterior surface of that membrane, in a slightly oblique course from above downwards and forwards, till it reaches the fore part of the ankle, where it receives the name of anterior pedal artery. In

Fig. 1

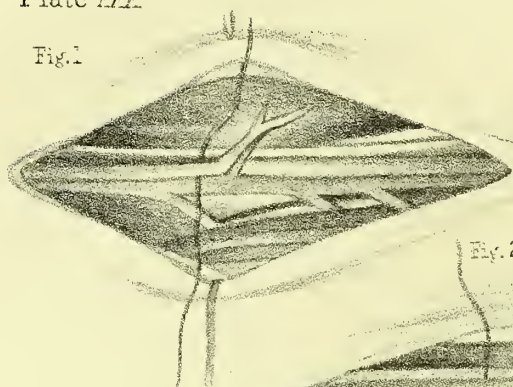


Fig. 2

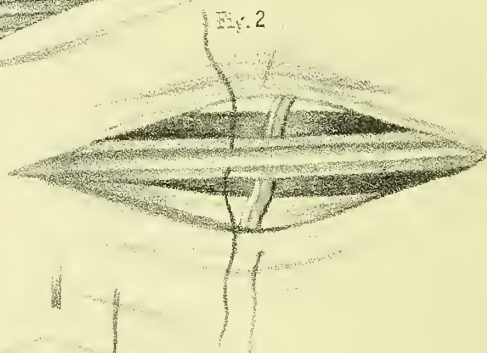


Fig. 3

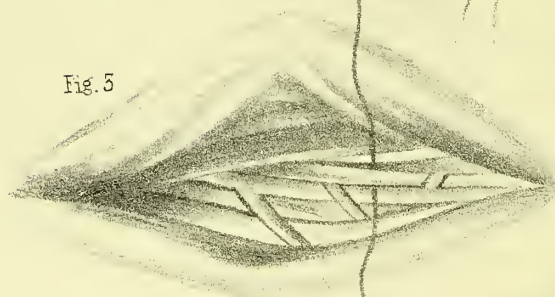


Fig. 4

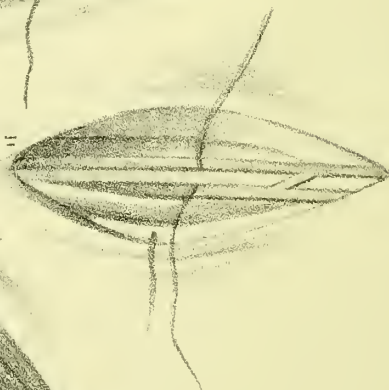
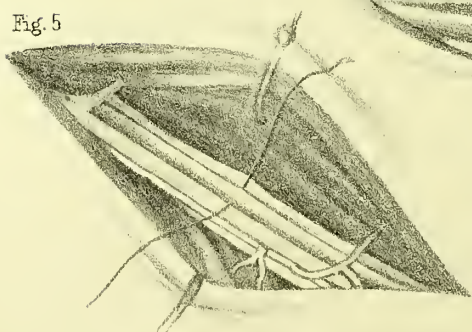


Fig. 5



this course the vessel with its venæ comites is very deeply seated in the two upper thirds of the leg, having the anterior tibial nerve at first external and then crossing it in a very oblique manner, so as to lie rather in front for a considerable distance. It lies at first deeply seated between the outer side of the tibialis anticus muscle and the extensor digitorum communis; and, owing to the prismatic form of the tibialis anticus, the broad superficial part of the muscle fairly overlaps the vessel. Lower down in the leg the extensor proprius pollicis, arising from the fibula and interosseous membranes, intervenes between the extensor communis and the artery, so that, for nearly the lower three-fourths of the leg, the artery is placed between the extensor of the great toe and the tibial muscle. Nearer the ankle the tibial muscle, becoming tendinous, passes forwards and inwards, out of relation to the artery, which then lies between the extensor of the great toe and the common extensor of the toes, the former to its internal side.

The best guide to the position of the anterior tibial artery, either at the upper or middle parts of the leg, is the outer edge of the tibialis anticus. This muscle is very broad above, and narrows as it descends.

Operation.—To tie the artery in the upper fourth of its course, the surgeon should make a long incision, slightly oblique, so as to follow the margin of the tibial muscle. This incision should not pass deeper than the surface of the aponeurotic fascia binding down the muscles, so that the operator may recognise the intermuscular line which separates the tibialis anticus from the common extensor. He should recollect that the upper portion of the latter muscle is very narrow, not above three lines in breadth, and that he is very apt to open the intermuscular line between it and the peroneus longus, and thus be led away from the artery. The assistant should be desired to extend and relax the ankle alternately, so as to show the outline of the tibialis anticus, before the fascia is opened, in the intermuscular line. The surgeon, with his finger or the handle of the scalpel, then separates the muscles and makes the assistant hold them forcibly apart. This exposes the vessels and nerve at the bottom of a deep and confined wound.

The artery is next cleared from its venæ comites and the nerve, the armed needle passed, and the vessel secured.

In the middle of the leg the vessel is reached more easily, as the depth of the interosseous space has diminished, and also the bulk and depth of the muscles. The incision is similar to that in the operation just described—along the outer edge of the *tibialis anticus*; but here the surgeon must recollect that that muscle is narrower, and that the extensor of the great toe is the muscle in relation with the vessels externally. In other respects the steps of both operations are similar.

THE POSTERIOR TIBIAL ARTERY is the direct continuation of the popliteal, and continues to descend a little to the internal side of the middle line of the leg, resting upon the *tibialis posticus* and *flexor communis* muscles, which separate it from the posterior surface of the interosseous membrane, until it reaches the hollow or arch of the calcaneum, where it terminates in the internal and external plantar arteries. About eight or ten lines below its origin, the posterior tibial gives off a large artery, or, more properly speaking, subdivides into the posterior tibial proper and the peroneal or fibular artery. This latter is very often the larger of the two vessels; in ordinary circumstances the peroneal artery descends for about two and a half or three inches parallel to and on the same plane as the posterior tibial, but gradually gets covered by the mass of the long flexor of the great toe, and so passes out of sight, and ultimately terminates in anterior and posterior interosseous branches, communicating both with the anterior and posterior tibial arteries and their malleolar branches. When the peroneal is the larger branch it takes the same course, but a little above the ankle it emerges from under the flexor of the great toe, and again joins the posterior tibial; so that, however small that vessel may be in the upper part of the leg, it is always found of large size behind the inner ankle. The great posterior tibial nerve descends almost exactly in the middle line of the leg, so that it lies immediately external to the posterior tibial artery and its accompanying veins, and internal to the peroneal artery—in other

words, exactly between, and in close relation to, both these vessels, so that it forms an unerring guide in the deep part of the wound, by which we may reach either vessel. The vessels and nerve are separated from the soleus by a layer of thin but strong fascia, which binds them to the deeper muscles. Then they are covered by the soleus and gastrocnemius muscles, fascia, and skin. Lower down, where the muscles of the calf of the leg have terminated in the tendo achillis, the posterior tibial is covered merely by the skin, superficial and deep fascia, and its course can be readily recognised by its pulsations.

The plan of operation which is very generally advised for tying the posterior tibial in the upper part of its course, is by means of a long incision through the integuments corresponding to the external or fibular border of the tibia, next dividing the fascia, and drawing outwards the inner margin of the gastrocnemius, and then either detaching the tibial origin of the soleus from the bone, or dividing its fibres from the surface towards the artery.

I consider that such a plan is not well suited to effect the purpose in the living, and that the direct plan recommended by the late Mr. Guthrie is much better, as enabling us to reach the vessel more directly, and really with less disturbance or dissection of parts; whilst, if it happens that the peroneal is the vessel requiring to be tied, that can be effected without any alteration of the original incision. I have twice had occasion to tie the posterior tibial—once at the middle, and once at the upper part of the leg; and from my experience in these cases, I have no hesitation in recommending the mesial or direct operation. In the former of these cases the vessel required to be secured in a lacerated wound, and hence the direct operation consisted merely in enlarging the original wound and tying the vessel. In the latter the operation was undertaken to secure the posterior tibial at its highest point on account of an arterial erectile tumour, apparently directly connected with it. In that case the posterior tibial was found to be very small, and its ligature produced no effect on the pulsation of the tumour; but, having taken the

direct method, all I had to do was to clear the parts to the outer side of the posterior tibial nerve, and tie the peroneal, which was nearly thrice the size of the tibial. Had I followed the lateral incision, and the exposure of the parts been less complete, the operation would have been very much more complicated.

The plan of operation which I followed on that occasion, and which I would recommend, was as follows:—I made an incision about six inches long, through the integuments on the back of the leg, dividing the skin and fascia. The posterior saphena vein was then cleared and held aside, and the incision continued, so as to separate the two heads of the gastrocnemius, to the extent of the superficial wound. One or two small vessels only required to be secured. I next divided the fibres of the soleus directly from behind forwards, till I recognised its deep aponeurotic surface. This I divided cautiously about the middle of the wound, and then with a probe-pointed bistoury dilated the opening upwards and downwards to the full extent of the superficial incision; two or three small muscular branches were secured, and the deep fascia slit up. The pulsating tumour then projected and filled the wound, but was gently held aside, and rendered less turgid by compression on the femoral. The posterior tibial nerve was now very distinctly seen, and the posterior tibial and its veins readily recognised and the artery tied; but, as I have said, it was very small and produced no effect. Seeing this, I slightly dissected the tissues on the outside of the nerve, and drew aside a vein which hid the peroneal artery, exposed that vessel, and tied it. The presence of the erectile tumour in this case rendered the operation more difficult than in ordinary circumstances: yet, the comparative ease with which the vessel was reached, and the parts at the bottom of the wound seen, render it in my estimation infinitely superior to working in a confined wound, the most important part of which is very imperfectly exposed. There is really no division of muscular fibres, except in the case of the soleus; for the two origins of the gastrocnemius are merely separated along their aponeurotic line of union, and the tendon of the plantaris drawn aside.

To tie the artery behind the inner ankle, the surgeon makes an incision of two inches long, placed nearly midway between the inner side of the tendo achillis and the inner border of the tibia and internal malleolus, care being taken to avoid the saphena vein. When the integuments and fat are divided, the strong aponeurosis which covers in the vessels is brought into view and slit open, the posterior tibial nerve is seen; and lying nearer the tibia, just behind the sheath enclosing the tibialis posticus and common flexor tendons, is the artery, with accompanying veins, from which it can be readily separated, and the ligature passed and tied.

LECTURE LXXIX.

Excision of Joints—History of the Operation—Its benefits as compared with those of Amputation—The Objects sought to be attained by the Operation—How these are Modified by Circumstances—Considerations for our Guidance in the Selection of suitable Cases for Operation : as regards the Patient, and the Extremity and Articulation affected.

AMONGST the improvements which mark the progress of modern surgery in our day, there is none which, in my opinion, deserves a higher place than EXCISION OF JOINTS as a substitute for amputation. In properly-chosen cases the results are most satisfactory, and the operation is more truly conservative than many methods of treatment which are so called. Whatever difference of opinion may exist as to certain excisions in the lower extremity, all who have witnessed the satisfactory results of excisions in the upper extremity, especially those of the elbow and shoulder joint, must admit the benefits conferred by these operations when contrasted with those derived from amputation of the limb.

Looking at the question of excision of diseased or injured joints, as seen in the results of modern surgical practice, you may be apt to wonder that such operations had not been had recourse to and become the rule of practice long ago. For excision of diseased joints is not a new operation. To say nothing of indications of complete or partial excisions of joints in ancient writers ; we find excision of joints not only practised by English and French surgeons, but special attention drawn to it by them as a plan of treatment suitable to diseased joints and as saving a useful limb ; whilst the results of their cases, and the arguments they adduce in favour of excision, leave very little to be added in the present day. Thus in England excision of the knee

was successfully performed by Mr. Park of Liverpool in 1781, and his views on the advantage of excisions in general were published in the form of a letter to Mr. Percival Pott in 1782, and also in the *London Medical Journal* in 1789. Mr. Park also mentions a case in which Mr. Filkin, a surgeon at Northwich, had performed excision in a case of diseased knee complicated by injury in 1762. Excision of the head of the humerus had also been performed by White of Manchester and Mr. Bent. And in France the Moreaus, father and son, practised excision of joints as a general rule, and the younger Moreau published a work on the subject. Notwithstanding all the success which had attended excisions of joints both in England and France, the operation never came into general use ; and it is undoubtedly to Mr. Syme that we owe its revival and advancement as a general method in the present day. Mr. Syme's work on *Excision of Joints*, published in 1831, drew general attention to the subject, and the success which attended his operations induced many surgeons to perform excision of the elbow-joint instead of amputation. Still the general adoption of the method was much less rapid than might have been expected from the success of the operation and the advantages to be gained by it. This partly arose from some surgeons misunderstanding the objects of the operation—viz. to remove the whole of the articular ends of the bones, and to obtain a movable elbow by means of a false joint. Some placed the limb after excision in rectangular splints, and kept it in the bent position to obtain ankylosis. Still more detrimental to the credit of the operation were the attempts to perform partial excision, such as resection of the olecranon or portions of the condyles of the humerus, which attempts were very generally followed by increased local mischief and grave constitutional disturbance, sometimes terminating fatally or requiring amputation of the arm secondarily. And then many surgeons, forgetting how long it is before the soft parts in the neighbourhood of a diseased joint regain their healthy character after excision, and how frequently in such cases sinuses form from time to time, took alarm, and not unfrequently performed

amputation secondarily, when a little patience and reliance on the curative powers of nature would have saved the limb.

I need not, however, dwell longer on the causes which delayed the general adoption of excision of joints in operative surgery, as it is now recognised as one of the greatest improvements in modern surgery ; but I rather draw your attention to the objects which we seek to accomplish in performing excision of a joint, and how these are modified in regard to excisions of particular articulations, or in relation to such operations in the upper and lower limbs, and the constitutional condition of the patient; for a variety of considerations must be carefully kept in view, to enable us to perform these operations intelligently, so as to obtain the best results, and to discriminate between cases suitable for excision, and those in which its performance might, from their unfavourable results, bring undeserved discredit on the operation.

In all cases of excision of diseased or injured joints, the paramount consideration is the complete removal of the diseased or injured parts, for unless we can accomplish this the operation is imperfect, and the result cannot be expected to be successful. The next consideration is to obtain as useful a limb as possible. Here our object, and consequently our mode of procedure, will vary, according as the excision is in the upper or lower limb. In the former, our object is to obtain a movable articulation, to admit of the free use of the arm and forearm. In the lower extremity a movable articulation renders the limb useless as a support, less useful than an artificial limb, and hence our object in such cases is to procure firm ankylosis in the straight position. In all cases our operations for excision should be effected with as little disturbance of parts as is consistent with the thorough removal of diseased structures. Finally, the risks to life, as compared with amputation, require to be considered in certain excisions, whether as depending on the state of the patient's health, predisposition to pulmonary or renal disease especially, or as depending on the dangers incident to particular excisions.

As regards the objects mentioned, all surgeons must admit

that we are very differently situated in regard to our power of effecting them in excisions of the upper and lower limbs.

In the former, if we perform the operation intelligently in reference to the objects to be accomplished, we can in general effect these fully and obtain brilliant results ; whilst in the articulations of the lower extremity, the paramount object,—that of removing all diseased structure,—cannot always be fully accomplished in some, whilst in others we are obliged to sacrifice the mobility of the joint to the necessity of having a sufficient support. I shall, therefore, first speak of the excisions of the upper extremity, as affording the most perfect examples of this operation.

In performing excision of the articulations of the upper extremity, we wish to remove all disease and to obtain a false articulation, which, under the control of the muscles, will admit of either the natural movements of the joint, or movements so closely resembling them that the use of the limb is but little impaired.

To effect these objects, we require to plan our incisions so that they may avoid division of muscles or tendons, so far as compatible with exposure of parts necessary for the complete removal of the diseased structures. With this view our incisions should be parallel to the axis of the limb, or nearly so, that the cicatrices may not interfere with the movements of the joint subsequently to the cure, and to facilitate the after-treatment and permit of passive motion being begun at an early period, even before the union of the wound has taken place ; this is specially important in the case of excisions of the elbow, but the principle is applicable to all excisions of the upper extremity. So far as possible, complete transverse division of muscles or tendons should be avoided, by making our section of muscular fibres more or less oblique, so that the divided fibres may unite more readily and with less loss of power. For example, in dividing the attachment of the triceps in excising the elbow, I divide it freely, from and on either side of the olecranon, by two oblique incisions uniting above at an acute angle so as to form

an inverted Λ , instead of cutting it across as is often done. Of course all tendons and muscles, attached to and covering the capsular ligament of a joint, as in the shoulder, should be thoroughly divided by a bold incision, so as to enable us to disarticulate easily ; and so must all muscles or tendons attached to parts of bone which are to be removed. In dealing with the diseased textures, all the affected synovial membrane present should be removed, by dissecting it off or by touching any small patches which are adherent with nitrate of silver, solution of chloride of zinc or perchloride of iron, or strong tincture of iodine. I generally use the chloride of zinc, and in cases of marked gelatinous degeneration I usually brush the surface of the wound with the solution when the resection is completed. In such cases, where we have diseased tissues, the chloride of zinc seems to produce a more healthy form of action, limiting suppuration and tending to more rapid consolidation of the parts. As regards the resection of the bones, all the articular surface entering into the formation of the joint must be sawn off, not only to an extent sufficient to remove the disease thoroughly, but when we wish to obtain a movable articulation by the formation of a false joint, we must remove some healthy bone beyond, so as to prevent the risk of coalescence of the resected bones and ankylosis occurring during the progress of the cure. From what I have observed of excisions of the elbow, I think the full benefits of the excision are often lost in consequence of not removing a sufficient quantity of bone, from the dread of leaving a "flail-like joint," a very rare occurrence indeed. Again, the surgeon is liable to be misled as to the amount of the articular extremities of the bones he has removed, if the mere bulk is looked to, for the excited action has generally caused enlargement of the bones and deposition of new bone around. I make it a rule to judge of the extent to be removed by the anatomical marks of the bones ; thus, in the elbow I invariably saw through the condyloid portion of the humerus high up ; indeed, if that bone be sawn through its flattened portion immediately above the olecranon and coronoid

fossæ, and the ulna divided below the base of the coronoid process, and the radius immediately below its head, there is no fear of a bad result. Whereas, if too little bone be removed, the risk of ankylosis is very considerable, especially in young subjects; and I have noticed this more particularly in cases in which the excision had been performed to remedy ankylosis arising from injuries, where the increased bulk and altered form of the bones are more apt to mislead. In such cases, the removal of bone should be very free. The only case of loose "flail-like" false joint I have met with in my own practice was in the case of a very debilitated man, in whom, owing to the extent of disease, I was obliged to saw through the humerus at the lower part of the shaft, quite above the condyloid part. It is now several years since the operation was performed, and though consumptive and apparently very weak, he still lives. When the arm hangs at rest, it certainly has a very "flail-like" and useless appearance; but when he calls the muscles into action, he has complete power over the joint, and can raise and sustain considerable weights—in fact he has very perfect use of the arm and hand. So that even this extreme case shows that a loose joint is not so very disastrous, and not likely to happen in ordinary cases. I have never had to regret removing too much bone in excisions of the elbow, but I can look back on cases in my earlier practice when I could wish I had removed more. Whilst on this subject, I confess that, holding the views I do, I am rather at a loss to understand the principle, on which dissecting off the periosteum below the point of section of the bone, and retaining it, is advocated; the object in doing so must be to favour the formation of the new bone, and that just renders the risk of ankylosis greater. I can perfectly understand it in cases of resection of the knee, where we desire a firm osseous union, but I must say I think it objectionable in cases where we desire a movable false joint after excision.

In excisions of the lower extremity, in which, as already explained, we aim at obtaining a firmly-ankylosed joint, to afford support to the body, in so far as our objects differ, so must our

methods of operation and after-treatment. The complete removal of all diseased tissue is equally imperative as in the excisions of the upper extremity, but here we limit ourselves to the least possible removal of bone compatible with the complete removal of disease. In many cases, after making our section of the condyles of the femur and tibia, we may find that the osseous surface still presents traces of disease, often in the form of parts of cavities containing tubercular-looking matter, or of points where the bone seems unhealthy. If the general surface of the divided bone seems unhealthy, then we require to remove a fresh section, and I think it better to do so then than to remove too large a section of bone at first, from the apprehension of diseased structure, which possibly or probably does not exist. In the cases where the cut surfaces present the remains of cavities, or small parts where the bone seems unhealthy, I consider the use of the gouge, and touching the surface with iodine, perchloride of iron, or chloride of zinc, quite sufficient, without requiring a fresh section, and consequent larger removal of bone. As regards our division of the soft parts, the complete division of muscles or the direction of our incision through the skin is of less consequence than when we want to obtain a movable articulation. Indeed, we often divide the hamstring muscles when the knee has been contracted, either as a preliminary or after resection of the bones, to enable us more easily to bring and retain the osseous surfaces in accurate apposition; whilst, in regard to the line of incision through the integument in the knee-joint excision, I feel satisfied that a slightly convex incision transversely from condyle to condyle below the patella is by far the simplest method of operating; the firm cicatrix, in this instance, is itself useful in giving solidity in front of the knee. In cases of excision of the hip and ankle, parts of the incisions must nearly always be transverse or curved.

Much has been said and written as to the comparative advantages of excision of the knee-joint over amputation, for disease of that joint. Objections have been made to excision, first, on account of the greater risk to life, and secondly, because of the

protracted cure and the nature of the limb preserved by the operation. In regard to the comparative risks to life, I shall have to consider that subject hereafter. At present I shall merely treat of the objections to the results of the operation in the cases where the patient ultimately recovers. It is quite true that the treatment of a patient after excision of the knee-joint is necessarily much more protracted than after amputation of the thigh; for, even supposing the wound to heal completely by the first intention, the limb must still be kept slung for at least seven or eight weeks, to insure solid union, and prevent the risk of bending; and even after the patient is able to move about with crutches, some time must elapse before much weight can with propriety be borne on the limb. In referring to these objections, Mr. Syme, in his work on excision, has well observed—"It ought to be recollected, too, that though recovery from amputation of the thigh is usually completed in three or four weeks, it is generally *at least as many months* before the patient can rest the weight of his body on the face of the stump, so as to use it in standing or walking. As to the utility of the limb, we find that it can be employed freely in progressive motion, and all the patients have declared that they considered themselves extremely fortunate in having preserved their legs such as they were. The advantages of the operation which may be contended for, are, that it preserves the natural support of the body afforded by the bones and joints of the tarsus, metatarsus, and toes, which, by diffusing the effects of force applied at the extremity of the limb, protects both it and the other parts of the body from concussion; and that it obviates the necessity of resting the whole of the patient's weight on the face of a stump, which must be done when amputation is performed above the knee."

Mr. Syme might have stated a longer period as being necessary before a patient should use an artificial limb; after amputation, I think at least eight months should elapse, after the stump has healed, before a support is used. As to the objection that the limb left is little, if at all, more useful than an artificial support, the advantages stated by Mr. Syme are fully corrobo-

rated by experience in the cases on which I have myself operated, and the larger experience of other surgeons. The results, as to the use of the limb and the little lameness observable in walking, have, I confess, surprised me. In one case of a young woman, on whom I operated in 1858, and in whom I removed more than the usual amount of bone, having thought it necessary to remove a second section from the condyles of the femur, I dreaded that the lameness would be very great, and she had a high-heeled boot fitted for the foot of the affected limb. A year afterwards I was astonished to see her at the hospital walking with scarcely a perceptible halt, and she informed me that the high-heeled boot hindered her walking, and, on using an ordinary shoe, she found her ease in movement so much greater that she had thrown aside the high-heeled boot; and this, I may state, has been the experience of all my patients, viz. that they walk best with a shoe or boot similar to that on the healthy foot. In other words, the obliquity of the pelvis, though scarcely noticeable, compensates for the shortening, whilst the movements of the hip and ankle joints compensate for the loss of motion in the knee; so that, in most cases, the limb left after excision of the knee-joint is very different from an artificial support, as regards the ease of the patient's progression. But, to take another aspect of this objection,—no surgeon would hesitate to prefer cure by ankylosis in the straight position in a case of diseased knee, to amputation of the limb. Now, that is just the result obtained by excision.

• In some cases it would appear that a joint which, after resection, was pretty firmly ankylosed, may gradually, from alteration in the bones, become movable, and form a false joint. I recently saw a patient under the care of my colleague Dr. Gillespie, in whom that gentleman had excised the knee, with a favourable result, three years ago, so that the man returned to his occupation, that of a miner. Gradually, however, his health became impaired, and he had pains in the parts near the wound. The ankylosis gradually gave way, and, after a variety of treatment, he insisted on amputation being performed. On section of the

parts, the condyloid portion of the femur was found atrophied, and its lateral section looks precisely like the bone from a stump of the thigh. A false joint had formed, and the femur worked like a pivot in a corresponding cavity in the head of the tibia. The original section of the femur, in the excision, was made through the upper part of the condyles. Deep in the head of the tibia a tubercular abscess was exposed by the dissection. I believe that the cause of alteration and atrophy was connected with the tendency to disease and the state of the constitution, and that, except for these conditions, amputation would not have been called for.

Such cases must be considered as very exceptional, and as by no means forming a valid objection to excision of the knee, only warning us to be careful in discriminating in our diagnosis what cases admit of thorough removal of the whole disease by resection.

Sir William Ferguson, in his interesting and instructive lectures on the progress of modern surgery, shows the great advantages gained by excision of the knee in successful cases, and his own practice has had great influence in giving excision of the knee its present position as a recognised operation in surgery. In the lectures I have alluded to he advocates its claims very strongly, perhaps rather exaggerates them. For, with all my appreciation of the advantages of the operation in certain cases, I am not insensible to the dangers attending it, and the necessity for discriminating as to the cases in which it should be performed, or to the inconvenience which may occasionally result when the resected joint remains very movable, or when the limb is not developed in proportion to the sound one, so as to be very much shorter. I cannot think that the sketch he gives at page 142 is likely to impress many with the advantage of excision over amputation, and I believe that, if that sketch were contrasted with a patient after amputation fitted with a good artificial limb, the contrast would rather be unfavourable to excision.

In regard to the EXCISION OF THE HIP-JOINT, I think that, looking to the pathology of morbus coxarius, and the extent to which

the acetabulum is generally affected at the stage in which we would be warranted in abandoning other curative measures and recommending excision, I doubt whether we could ever be sure of removing the whole diseased structure,—in other words, whether we could effect what I have stated as the paramount object of excision of a joint. It has been said that this resection is analogous to the excision of the shoulder, where we seldom require to remove more than the head and tuberosities of the humerus. The two cases are essentially different in many respects—first, the disease in the shoulder-joint is very generally confined to the head and tuberosities of the humerus, very often commencing in the latter, or in the upper part of the bicipital groove; whilst I cannot recollect of ever having seen a specimen of morbus coxarius where the acetabulum was not affected, and generally to a great extent. But, apart from the foregoing considerations, the great practical difference lies in this, that the scapula does not form a part of any of the great cavities of the body, so that we can remove, if necessary, not only the diseased surface of the glenoid cavity, or indeed that cavity entirely, by curved bone-forceps, but even a large portion of the scapula, or the whole bone; whereas, in morbus coxarius, the acetabulum, if largely diseased, could not be so dealt with, as it forms a part of the walls of the pelvic cavity. In cases of advanced hip-joint disease, where the carious and dislocated head of the femur is felt bare through some sinus, or in the cavity of an abscess, I should consider it advisable to lay the sinus or abscess freely open, and resect and remove the carious portion of bone; but I cannot see much likelihood of excision of the hip-joint (properly so called) becoming a successful operation.

EXCISION OF THE ANKLE-JOINT, for disease, is a comparatively rare operation: by proper care and treatment, when the disease occurs in young persons, and where it is limited to the joint, a cure by ankylosis can generally be effected. Persons above middle age are rarely the subjects of such disease, and if they were, excisions are not very successful at that period of life; whilst, if any of the tarsal bones, except the upper articular

surface of the astragalus, be involved in the disease, I consider amputation at the ankle the more suitable measure. But, though I have had no personal experience in regard to excision of the ankle-joint for disease, I can conceive of some cases where it might be practised with advantage ; and from what I know of the ease with which the articular surfaces can be removed in compound dislocations of the ankle, without injury to the blood-vessels or tendons round the ankle-joint, I think that, in cases of disease proper for the operation, it might be readily accomplished, without dividing any important structures, so as to leave a very useful limb, preserving the movements of the foot, so that I should be inclined to perform it if I met with a suitable case.

In regard to partial resections of the foot for removal of diseased bones, except in the case of cario-necrosis of the os calcis, from what I have seen of such resections, and experience of my own cases, I have a very unfavourable opinion of such operations. I have, in some cases, removed one of the cuneiform bones, and also the cuboid, with success ; but in most cases these operations are followed by mischief in the neighbouring tarsal articulations and bones, erysipelatous inflammation of the foot sets in, accompanied by irritative fever, and amputation of the foot, or, it may be, of the leg, is ultimately required, if the patient escapes the dangers of irritative fever or pyæmia. I believe that such operations are attended with much greater risk to the patient's life than the results of even occasional successes warrant us to encounter, and hence I prefer non-interference in such cases, or merely gouging out the carious surface, without meddling with the articular surfaces ; or, when interference is imperative, I consider either partial amputation of the foot, or at the ankle, the safer practice—the more so, that in such cases all the tarsal bones are generally predisposed to disease ; so that, even in cases where partial excisions have been temporarily successful, the disease often returns in other portions of the tarsus, and amputation has at last to be resorted to. In these general remarks on excision of joints I have almost entirely re-

ferred to the operation as performed for disease. In my lectures on gunshot wounds I very specially pointed out its advantages as a primary operation, and the great success which had attended its performance by military surgeons. The same results would follow its performance in similar cases in civil practice ; but, unfortunately, the compound dislocations, or fractures, met with in civil practice, are attended with so much destruction of soft textures, or so complicated with other severe injuries, as either to forbid the operation, or to leave but little chance of success ; but in proper cases, especially in the upper extremity, it ought certainly to be practised in preference to amputation.

LECTURE LXXX.

Comparative Mortality following Excision and Amputation in Upper and Lower Limbs, as seen from Statistics—Causes of the Mortality exemplified by Illustrative Cases—Instruments and Apparatus required for the Operation and After-treatment of Excision of Joints.

THE question of the comparative mortality in cases of excision of joints and of amputation can, I think, have reference only to these operations in the lower extremity. In the upper extremity a fatal issue after excision is very rare as compared with amputation. As regards my experience in my own practice, I find that out of 112 cases of excision of the elbow-joint I have lost only 6 cases. In 17 cases of excision at the shoulder-joint I have met with no fatal result ; and in 8 cases of excision of the wrist I have met with no fatal case, but in two of these last, amputation of the forearm was required subsequently. Of the 6 fatal cases of excision of the elbow, 2 died of acute pyæmia, 1 of pyæmia complicated with acute albuminuria. In one case, the patient, a young man, died of albuminuria five months after the operation. The symptoms began to develop themselves six weeks after the operation, and the wound of the operation was healed four weeks before death. The fifth fatal case resulted after the only primary excision which I have had an opportunity of performing, and the young man had sustained numerous injuries—namely, cerebral concussion and fracture of the ribs. He died the third day after admission into the hospital. In the sixth case—a very emaciated child with phosphaturia—the wound would not heal, amputation was performed, but he gradually sank exhausted. It seems to me that excisions of the upper limb are attended with less danger to life than any other operation of equal severity.

In regard to these statistics of my experience in the

excisions of the upper extremity, I have been struck with the great difference in the number of excisions of the wrist and shoulder in comparison with those of the elbow-joint.

Looking over my journals of private and hospital cases, I find that this disproportion seems due to three causes :—*1st*, That diseases of the wrist and shoulder seem to be of very much rarer occurrence ; and *2dly*, That they are in the early stages more amenable to treatment ; and *lastly*, That many refuse to submit to any operation till the parts are so disorganised and the health so bad that amputation is the only resource. In one year alone I find that of 7 cases of disease of the shoulder 5 were dismissed cured by the use of the cautery, combined with the use of cod-liver oil, iodide of potash, and nutrient diet, whilst only 2 required excision ; whilst in the same year 5 cases of wrist-disease occurred,—two refused to consent to excision, and were relieved by treatment, one was dismissed cured, in one amputation was performed, and one underwent excision, and recovered.

In the lower extremity the results in regard to life are not so favourable. Excision of the knee-joint, so far as the operation has yet been tested, can scarcely contrast favourably with amputation at the lower part of the thigh for disease of the knee-joint. I am aware that favourable comparisons have been made by contrasting cases of excision of the knee-joint with amputation of the thigh generally ; but the comparison, to be a fair one, must be between cases of amputation performed for diseased conditions similar to those for which the excision is had recourse to. My experience of amputation has shown me that, not only the extent of the limb removed, but also the nature of the disease for which it is removed, make a great difference as to the success or fatality of the operation, and that amputation in cases of simple strumous disease of the knee-joint affords the greatest amount of success ; and this is the class of cases for which we perform excisions. With all my feeling in favour of excision of the knee-joint as a substitute for amputation of the thigh, I cannot help believing that in certain conditions it is more dangerous than amputation, and that the character of the

operation is likely to be perilled by its being indiscriminately resorted to. In reference to the absolute advantages of excision of the knee over amputation as regards the results in successful cases, no one can doubt that, and I think the question now to be considered in regard to the comparative mortality of these operations is to endeavour to discriminate between the cases in which the one or the other of these operations presents the least risk to life. Here, as in amputation, it is difficult or impossible to gain much from mere general statistics. What we want to know in considering such a point is, all the circumstances of the cases operated on, which may have influenced the result, and hence the surgeon will learn more from, and naturally be more impressed with, the results of his own cases, or of cases which he has opportunities of closely observing. My own experience of excision of the knee-joint is comparatively limited, and therefore, in stating to you the results, any deductions I may draw from my cases are to be regarded as merely suggestive, not positive.

I have performed excision of the knee-joint 18 times ; of these 9 have recovered, and 8 died, and 1 is under treatment. 17 of the cases operated on were for disease, and 1, a primary excision, for injury. 14 of the patients were females, and 4 males.

Of the 9 successful cases 8 were females : in 6 of these the ages varied from 20 to 25 ; 1 was a little girl, aged 7 ; and 1 was a young man, aged 20.

The diseased conditions for which the operation was performed were as follow :—In the cases of the young adult females there was disease of the articular ends of the bones, leading to ulceration of the cartilages, attended with great local pain and constitutional disturbance ; but in all of them, notwithstanding the severity of their suffering, there was less wasting of the body and less impairment of the general health and strength than might have been expected. In the case of the young man, ankylosis in the bent position had resulted after long-continued disease of knee-joint, which, so far as the history could be ascertained, seemed to have been disease of the bones and cartilages ;

and at the time of his admission into the hospital there were deep-seated pains in the bones, and the section removed showed the existence of articular caries at some points where the osseous ankylosis was incomplete. His general health had previously suffered during the progress of the disease, but he had regained health and strength after the joint became stiff, but was again beginning to suffer, from the pain preventing rest at night. In the case of the female child, the disease was originally gelatinous degeneration, which had yielded to treatment in the hospital on a previous occasion, but had begun afresh. In her case, also, the joint was partially stiff; her general health was beginning to suffer, but she was by no means exhausted at the time of the operation. In this child's case there was very severe hæmorrhage from the bones some hours after the operation, which could only be arrested by a pad of lint, dipped in perchloride of iron, being placed between the condyles of the femur and tibia, and retained for some hours; after its removal no more bleeding occurred.

Of the fatal cases, one was a case of primary excision in a man about 45 years of age, who jumped from a railway carriage whilst the train was in motion. He sustained several other injuries—concussion of brain and a small lacerated wound of the scalp, and simple fracture of the upper arm. The injury of the knee consisted of a very fine semilunar wound (made nearly as cleanly as with a knife), laying open the knee-joint. The convexity of the flap looked upwards—that is, in the direction opposite to that in which we should make the incision in operating. The internal condyle of the femur was fissured, and fragments broken off. No new incisions required to be made. The slices of bone removed were not of any great thickness, and no ligatures were required. At first the injury of the head rendered him restless and difficult to manage, but after a few days the head symptoms passed off, and he went on most favourably for more than three weeks, when suddenly rigors occurred, pyæmia set in, and he died about five weeks after the injury. The lower end of the femur, above the section of the condyles, was found bare, as from acute necrosis. There was no swelling of the thigh to be seen or felt during

life, nor did he complain of uneasiness at the wound, a great part of which was consolidated.

Another of the fatal cases occurred in a man about 30 years of age, of very strumous constitution and spare habit of body, but not very much exhausted by the disease, which was chronic gelatinous degeneration of the synovial membrane. In this case the cause of death was very obscure. The operation was very easily and quickly performed; there was less than the usual amount of bleeding during the operation, and the wound was not a large one. After the operation some venous bleeding occurred, which, however, was quickly and easily arrested by snipping the bandage above the knee and applying cold. There was no bleeding into the cavity of the wound—no distension—and the ends of the bone were kept in accurate apposition; but he never rallied fairly from the operation, and died within forty-eight hours. There was no affection of the lungs or chest to account for death. I presume we must classify the cause under the convenient term of “shock,” though, as he was not at all nervous prior to the operation, and felt nothing of it, and was neither restless nor complained of pain after it, it is difficult to understand in what the “shock” consisted. A lad, aged 19, on whom I operated for gelatinous degeneration, died under peculiarly annoying circumstances. So far as the excised knee-joint was concerned, the wound healed nearly by the first intention, and consolidation proceeded favourably. So little pain did he suffer that he never moved the limb in the slightest degree, and the apparatus never required to be removed for five weeks, and then only to change the bandages for cleanliness. His appetite was good, and he slept well. The only bad symptom was that the pulse was more frequent than consistent with the general symptoms. He was looked upon as convalescent, when suddenly the opposite foot and leg began to swell. The urine, which had formerly been normal, was now found to contain albumen in considerable quantity. Notwithstanding all treatment, the condition proceeded, occasionally yielding for a time, and then becoming worse. He died nearly four months after the operation,

the wound having healed long previously. In two others of the fatal cases the patients were females, one 40 years of age, and the other 45. Both had on former occasions suffered from necrosis of the femur, which had been cured previously to the appearance of the affection of the knee, for which excision was performed. Both did well for some weeks, and then pyæmia, complicated with albuminuria, supervened, and terminated fatally. Pyæmia also proved fatal in the case of a female, aged 35, on whom I performed excision for gelatinous degeneration; and a very acute form of pyæmia caused the death of a young girl on whom I operated on account of acute ulceration of the cartilages, arising from disease of the bone. In this case the girl had suffered excessively from pain and irritative fever before admission into the hospital. I was anxious for a post-mortem examination in the last case, but it was not granted.

Another of the eight fatal cases occurred after excision for ulceration of the cartilages caused by masses of fimbriated bodies from the synovial membrane. The patient, a female, though nervous and excitable, was not by any means weak, but suffered intense pain on moving. The disease, though extensive in surface, was of little depth. The sections of the bones were accordingly very thin, and the bone underlying the sections removed was sound, and rather more solid than usual. All the synovial membrane was carefully removed. The disease seemed so completely local and limited, and the general health so good, that I anticipated a very favourable result, but she became very excited, and depressed mentally, and died within a week after the operation, apparently from constitutional irritation, and without any symptoms of pyæmia. I have entered more fully into the nature of the fatal cases, with the view of directing your attention to some circumstances in regard to them. As to the successful cases, I have only to remark that, with the exception of the little girl, they all presented certain features in common. In all, the disease was in osseous texture, and tolerably limited. All of them were young adults, and in none of them were the general powers of the constitution exhausted, although the local

sufferings were in most of the cases intense. They were, in fact, cases which augured well for the result, and good specimens of a class of cases which I had indicated in some remarks on excision of the knee, in my Clinical Reports 1858-9, as being specially suitable for the operation—viz. “cases where we find severe local disease of the joint, apparently limited, and of long standing, resisting all the usual remedies, and becoming exacerbated whenever the patient tries to use the limb, but where, at the same time, the general health has not suffered in any great degree.” The causes of the issue in the fatal cases are deserving of attention. The result in the case of primary excision is scarcely to be wondered at. The man was above middle age, intemperate, and suffered various other injuries ; and it accords with my experience of primary amputations, that the presence of other lesions, although not even very dangerous in themselves, such as simple fracture of another limb, or slight injury of the head, have always a most marked influence in determining an unfavourable issue at a late period, and in an insidious form, as in the case alluded to, apparently depressing the vital power and inducing pyæmia. I think the nature of the cases with which we have to deal in civil practice, as exemplified in the fatal cases of primary excision at the knee and elbow which I have recorded, serves to explain the difference from the great success in primary excisions in military practice for bullet-wounds ; but whilst we cannot consider such cases as mine as favourable for excision absolutely, I believe that their chances were at least as good as, I should say better than, after primary amputation in similar circumstances, and in less complicated cases decidedly preferable even as regards the risk to life. As to the cases in which the excision was performed for disease, the two in which the fatal result is least explicable, and where I certainly anticipated success from the conditions present, are the case of the man who died forty-eight hours after the operation, apparently not rallying from the “shock.” I have given the details, but as I confess I have never been able to satisfy my own mind as to the cause of death in his case, I shall not

waste your time by attempting any explanation. The other case is that of the young woman with fimbriated disease of the synovial membrane, and ulceration of cartilages and subjacent osseous surfaces. In her case I expected, from the perfectly healthy state of the bones beyond the ulcerated surfaces, the limited nature of the disease, and its complete removal, and the absence of all marked strumous diathesis, that there was less than usual risk, but she died very rapidly from irritative fever rather than pyæmia. She was excitable and nervous, and I believe her restlessness kept up the local, and so induced the constitutional irritation. At the same time, the question suggests itself, how far the diseases of the synovial membrane are favourable for this operation? In the case of the lad who died of albuminuria, and also in the case of a female thirty-six years of age, the disease was gelatinous degeneration of the synovial membrane, which was completely and readily removed. It seems rather hard to have to count the lad's case as fatal from the excision, for I never saw a case of excision where the operation was attended with less local or general disturbance, or where the wound healed more kindly. I have, however, pointed out the tendency to amyloid degeneration of the kidney, and also to congestion of the kidneys and acute albuminuria, in cases of gelatinous disease of the synovial membrane, and therefore I fear we must look to this as one of the causes of fatal issue when we are estimating the chances of success, and in all such cases it should ever be borne in mind with reference to the after-treatment of our cases. In the case of the woman, her age, and the long continuation of the disease, were also unfavourable elements. The remaining two adult females who died after the operation, had both suffered for years from scrofulous necrosis of the shaft, which had been cured prior to the knee becoming affected.

In regard to amputation of the thigh, I shall have occasion to point out to you, as the results of my experience, that the pre-existence of necrosis to joint-disease makes a marked difference on the unfavourable results of amputation at the lower third of

the thigh, and here we find the same holds good. This, as I have said in reference to amputation, seems to me to be due to blood-taint in scrofulous necrosis, and the previous long-continued irritation and suppurations during the progress of the necrosis, so that even when the bone has separated, and the wound healed, the recurrence of the joint-disease indicates an unfavourable state of the constitution, whether for amputation or excision. Another unfavourable element in these two cases was the age of the patients, one being forty and the other forty-five years of age. In the case of the girl who died, the disease was acute cario-necrosis; and when admitted into the hospital, she was suffering from intense irritative fever. When this was subdued, the disease being limited, I considered her case suitable for excision; but I fear the state of the blood and nervous system in such cases is unfavourable for the operation, and that amputation would probably have a better chance of success. The unfavourable conditions then are—debility from disease, or originally weak constitution, advanced age—beyond forty years of age is, as a general rule, unfavourable for excisions of the knee, and the coincidence or previous existence of necrosis is also an unfavourable complication in my estimation.

In many instances of synovial degeneration, especially in cases in which, under previous treatment, partial ankylosis has been effected; and where the patient is not much exhausted, excision of the knee-joint is suitable. But I cannot consider that gelatinous degeneration is so favourable as articular caries, owing to the state of the constitution which generally accompanies the former condition. In cases of young lads or boys of pale, pasty-looking complexion, and in whom abscesses containing curdy or tubercular looking pus, have formed around the joint, I should decidedly give the preference to amputation of the thigh, as being attended with less risk to life.

The INSTRUMENTS required for performing excision of joints are—a tourniquet, to prevent bleeding during the operation; strong, sharp-pointed bistouries, for the incisions; a straight bistoury, rounded and blunt at the point, which may be useful

in some excisions, such as those at shoulder and hip ; a saw with a movable back, and a blade eight inches long and three-quarters of an inch broad, the shifting back being so arranged that it is thrown off during sawing ; narrow saws of different lengths (Langenbeck's) which are useful in some resections, and are more efficient than the chain saw ; bone pliers of different sizes and forms ; gouge, and gouge forceps ; a pair Sir William Ferguson's lion forceps to grasp detached portions of bone, and give lever power ; a pair small necrosis forceps ; metallic spatulæ to hold aside and protect the soft tissues during section of the bones ; artery forceps ; suture needles, and the other instruments needed in all operations. The apparatus for after-treatment consists of cushions or pads of lint, and different forms of splints, which are chiefly needed in special resections, and will be described when speaking of these. A small quantity of solution of chloride of zinc should be at hand to touch any parts of the diseased synovial membrane, which cannot be dissected off.

LECTURE LXXXI.

Excision of Shoulder-Joint : Steps of the Operation : After-treatment—Excision of Elbow-Joint by Longitudinal, H and T Incisions—Circumstances under which one or other should be preferred—Operation—Excision of Wrist-Joint—Instruments used and Operative Procedure.

THE general principles on which excision of joints should be performed having been considered, I shall now describe the methods of performing the principal excisions or resections, commencing with those of the upper extremity.

EXCISION OF THE SHOULDER-JOINT has been very frequently performed in cases of disease of the head and tuberosities of the humerus, or for gunshot wound ; and various lines of incision have been tried to effect this resection. Mr. White of Manchester, who was amongst the first to propose this operation, used a single longitudinal incision through the central line of the deltoid. Others dissect up either a semilunar, or V-shaped flap of the deltoid, so as to expose the surface of the joint, open the capsular ligament, turn out the head of the humerus, and saw it off immediately below the tuberosities. The plan of operation, however, which I consider to be preferable to all others, as enabling the surgeon to disarticulate with greatest ease and with least loss of blood, is a longitudinal incision made over the internal aspect of the joint, which enables the operator to expose the head and tuberosities of the humerus, where they are most prominent between the coracoid and acromion processes of the scapula, then by a slight rotation of the arm outwards, to expose and render tense the broad attachment of the subscapularis into the lesser tuberosity, and to divide this easily, which may be said to be the key of the operation. Again, when in a dissection we reflect the deltoid muscle, it will be observed that the great posterior circumflex artery, which

supplies the deltoid chiefly, attaches itself to the deep surface of the posterior part of that muscle after winding round the neck of the humerus below the tuberosities ; and this large vessel being only loosely connected, would, if divided posteriorly, retract and bleed very copiously. As it passes forwards, however, entering the substance of the deltoid, it diminishes in size, and, at the anterior margin of the deltoid, only exists in the form of its ultimate muscular twigs ; it follows that both in excision and in amputation at the shoulder, we should if possible avoid division of this artery near its origin, or where it lies under the posterior portion of the deltoid.*

The operation is performed as follows :—The arm being slightly abducted, the surgeon feels for the projection of the head of the humerus immediately external to the coracoid process, and entering his bistoury just in front of the point of the acromion process, he cuts directly down upon the head of the humerus, and carries his incision deeply, downwards and slightly outwards for at least three inches and a half, or four inches. This incision should fairly divide the deltoid. On drawing aside the margins of the incision with blunt hooks, the internal and anterior aspect of the joint is seen, and the long tendon of the biceps lying in the upper part of the bicipital groove. The anterior circumflex artery is generally divided in this first incision ; and this, as well as any small muscular branches which bleed, should be secured before proceeding further. The external margin of the wound is then drawn well outwards, and if the deltoid be very powerful, or its fibres altered and condensed by disease so as not to allow it to be easily retracted with the skin, a small incision may be made across its anterior fibres immediately under the acromion. This thoroughly exposes the external tuberosity. As the arm hangs well over the table, the assistant moves the elbow slightly backwards to project the head of the humerus forward, and the surgeon, using his knife as if he were about to cut into the bone, divides at one sweep the capsular ligament and the attachments of the muscles inserted

* Plate xxxviii. Figs. 1 and 2.

into the greater tuberosity. The joint is thus largely opened, and then, by rotating the arm outwards, the tendon of the subscapular muscle attached to the lesser tuberosity of the humerus is brought fully into view, and easily divided. The arm hangs loosely, and the assistant projects the head of the humerus by drawing back the elbow (the elbow in this method of operating should not be thrown across the chest, as that buries the head of the humerus under the deltoid), so as to allow the surgeon to divide any portions of the capsular ligament which remain, and to clear the bone for sawing it below the tuberosities. In this part of the operation the edge of the bistoury should be constantly directed towards the bone, so as to avoid injury to the posterior circumflex artery, or even the great vessels; and in cases of disease, when the textures are very unyielding and the incision contracted, it is advisable to use a round blunt-pointed bistoury for this part of the operation. When the head of the bone is sufficiently cleared and projected, by the arm being drawn forcibly back and maintained firmly in that position, the operator, steadying the head of the humerus with his left hand, applies the saw and removes the diseased or injured part, taking care to remove no more than what is absolutely necessary. Any vessels which bleed are now secured, and then the state of the glenoid cavity is carefully examined. If not diseased, nothing further is required—if diseased, the carious portion may be removed with the gouge-forceps, or bone-pliers and gouge, or the whole glenoid articular surface may be clipped off with large curved bone-pliers; but this is seldom required. When there has been much suppuration in or around the joint, I usually, after the resection is completed, introduce my left forefinger into the wound and pass it downwards and backwards to the most dependent part of the cavity, and then, introducing a bistoury upon the finger, make a counter-opening of about an inch and a half in length, to allow the discharge to escape freely in that direction. A piece of perforated india-rubber tubing is passed through the wound, to keep the track open and enable us to wash out the cavity with antiseptic lotions. This plan I have

found very useful in preventing the matter collecting in the cavity of the wound when the patient is lying on his back.

When the operation is completed, the incision is united by points of interrupted suture. A long flat pad, thicker above than below, and covered with gutta percha, is placed in the axilla and between the arm and the side, the forearm and elbow supported in a sling, and the elbow fastened to the side by a circle of broad bandage. The wound is simply dressed with dry lint, except in cases where there has been much suppuration. In such cases I wash the wound with solution of chloride of zinc (1 part to 30 or 40), and use a weak tepid chlorinated soda lotion, or Condyl's fluid for dressing, for some days. At the end of four or five weeks, gentle passive movements of rotation and abduction should be cautiously begun. The general result of this operation is most successful. I have performed the operation seventeen times, and some of these cases looked very unpromising, but I have never lost a patient; while in all of them the arm left has been most useful, and in many the amount of power regained was very surprising. The patient represented in Plate xxxii. Fig. 2, seemed, prior to the operation, a very hopeless case, but his general health and muscular power have been re-established ever since the removal of the diseased parts.

EXCISION OF THE ELBOW may be effected either by means of a simple longitudinal incision, or by incisions in the form of H or $\perp$. As I have already indicated the general principles to be attended to in planning our incisions in resections of joints in the upper extremity, and in the section of muscles and tendons in these operations, in reference to the after-treatment and usefulness of the limb, I shall now limit myself to describing the steps of the operation—beginning with the operation by the longitudinal incision, which, as a general method, I prefer.

In performing this operation, the humeral artery having been commanded by the tourniquet or manual compression, the assistant, standing on the side of the patient opposite the diseased limb, grasps the arm above and below the elbow, keeping it very slightly flexed

Fig 1

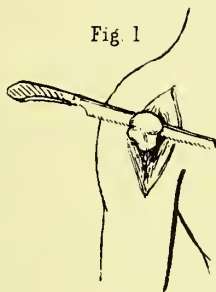


Fig 2



Fig 3



Fig 4

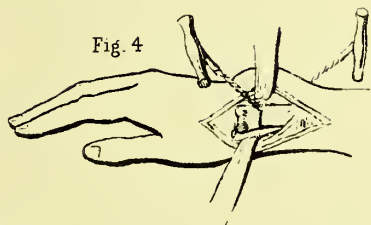


Fig 5

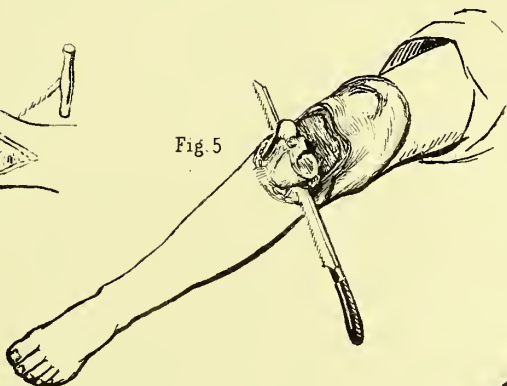


Fig 7



Fig 9

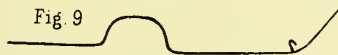
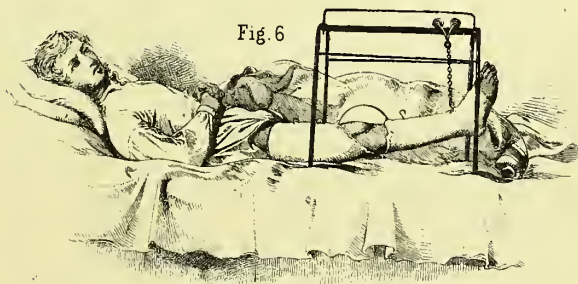


Fig 8



Fig 6





and raised from the body. The surgeon, standing on the same side as the diseased limb, inserts his knife in the middle line of the posterior aspect of the upper arm, about two and a half inches above the elbow, pushes it directly down to the bone, and carries it rapidly downwards, inclining the incision a little inwards as it passes over the olecranon and upper part of the ulna, and terminates the incision two or two and a half inches below the joint. He should next separate the triceps on the outer side by cutting very obliquely downwards and outwards, the edge of the knife being directed to and rasping upon the ulna, so as to separate the muscular fibres in connection with their periosteal attachment; and then this deep incision is continued downwards and outwards to separate all the textures over the outer condyle and head of the radius. This relieves the tension, and enables the operator to deal more easily with the more important step of separating the parts on the inner side of the joint. The surgeon divides the inner half of the triceps in the same manner as on the outside; but on reaching the line of the internal margin of the olecranon, the operator must recollect the proximity of the ulnar nerve, and, to avoid injuring it, must keep the edge of the knife directed towards the ulna as he cuts downwards. He then separates the parts from the humerus and ulna sufficiently to enable the textures, including the ulnar nerve, to be drawn over the internal condyle, and allow it to be fairly exposed. The assistant should now bend the arm further, to render the lateral ligaments tense, so that they may be freely divided. This is most readily effected by cutting upon or just below the condyles of the humerus, where the ligaments are narrowest, and can be divided by a single stroke of the knife. The elbow is then forcibly flexed, and the upper ends of the ulna and radius dislocated or projected backwards, exposing somewhat their anterior aspect, which may be still attached by the anterior ligament or portions of it. The operator clears the anterior aspect of the coronoid process by cutting obliquely down to and upon the bone, so as to separate the periosteal attachment of the brachæus anticus tendon from the bone, then, clearing the radius and ulna by a circular sweep of

the knife, he applies the long narrow saw, and cuts them through a few lines below the lesser sigmoid cavity of the ulna. Lastly, he clears the lower part of the humerus, and saws it off through the upper part of the olecranon fossa, and rounds off the angles of the section with the bone-pliers. All diseased synovial structure should, as far as possible, be clipped away or dissected off; and any portion which remains, or any suppurating texture, should be painted over with a solution of chloride of zinc (1 part to 30). The vessels which usually require to be secured are the branches of the inferior profunda which accompany the ulnar nerve, and the anastomotica magna on the inner side, and the radial recurrent and posterior terminal branch of the superior profunda externally; but all bleeding points must be secured by ligature, or other means, before closing the wound, which is then to be closed by an interrupted suture. The central stitches should be left untied, the wires or thread being left long so as to be tied after six or eight hours, when all oozing has ceased, and after any clots which may have formed have been removed. The dressing is simple: a long, rather thick pad, of the breadth of the limb, is placed in front of the arm, which is kept slightly flexed, then two lateral pads on either side of the wound. These pads are secured by a figure-of-8 bandage, so applied as to leave the wound free, a light veil of lint is laid over the wound, or no dressing at all to the cut surface. The limb is then laid on a pillow, and the arm secured so as to prevent the humerus being tilted outwards, which would cause the condyloid end of the bone to press upon the skin, and might lead to ulceration.

In cases where the joint is ankylosed the soft textures may be dissected off, so as to allow the removal of the articulation in a mass after resection with a fine narrow saw, or the operation may be facilitated by cutting off the olecranon with bone-pliers; and some surgeons take this latter method in all cases, but there is really no necessity for doing so generally.

Excision of the elbow by the H or $\neg$ incision is very similar as to the final steps of the operation, the chief difference being in the dissection of the parts on the posterior aspect of the joint

in the form of flaps, so as to expose the bones more fully. In either of the two plans last mentioned, the operator begins by making a transverse cut from the internal margin of the olecranon process to the articulation between the outer condyle of the humerus with the head of the radius. He next makes an incision, about three inches long, parallel to the axis of the limb, and close along the inner border of the olecranon. This completes the lines of the **T** incision. If the **H** incision is to be used, another longitudinal cut is made at the outer end of the transverse incision. In both methods the surgeon next proceeds to separate the parts between the internal incision and inner condyle; and as these contain the ulnar nerve, the edge of the knife should be kept close to the olecranon and ulna, to avoid injury to the nerve, and then the separated parts drawn inwards, and protected by a broad metallic spatula. The flaps marked out by the line of incision are dissected from the bones, the lateral ligaments divided, the ends of the bones dislocated, and projected and sawn off as described in the operation by the single longitudinal incision.

In these last methods everything depends on primary union of the transverse incision taking place, and hence the limb must be kept very quiet. Should primary union of the transverse cut fail, passive motion cannot be begun without interfering with the healing process; whilst in the longitudinal method we can begin passive motion, even though primary union should fail, without doing harm. Having performed the operation repeatedly by all three methods, I feel satisfied that the long posterior incision is preferable in many respects, and quite as easy of performance as either of the other two.

What has been said of the mode of dressing applies equally to all the methods.

EXCISION OF THE WRIST-JOINT, owing to the nature of the parts to be removed, and the necessity for avoiding the division of tendons and blood-vessels to preserve the movements of the fingers afterwards, is an operation partaking so much of the

nature of a dissection that it requires more time and patience on the part of the operator than any of the other excisions of joints. There is not, however, any special difficulty in the operation, apart from particular conditions of the diseased parts, such as the broken-up disorganised condition of the carpus, in some cases necessitating the removal of the diseased fragments, as it were, piecemeal. I have performed the operation in several cases in from ten to fifteen minutes, whilst in others I have required fully forty minutes to complete it properly.

I usually adopt, with some slight modifications, the plan described and figured in Bourgery and Jacob's *Operative Surgery*, only that, instead of the chain-saw there represented, I use a narrow saw (Langenbeck's) and the bone-pliers for the section of the bones.

The operative procedure is as follows:—A tourniquet having been applied over the brachial artery, the surgeon makes an incision from about an inch above the styloid process of the radius, along the outer and posterior aspect of that bone, over the radial side of the carpus and outer back part of the metacarpal bone of the index finger to at least an inch below its connection with the carpus. He next makes an incision on the inner and posterior aspect of the wrist, extending from an inch above the styloid process of the ulna, descending in a slightly slanting direction outwards (radiad) to a point an inch and a half below the articulation of the fifth metacarpal bone with the carpus. These incisions should only divide the skin and fascia. The operator next carefully dissects the tendons from the grooves on the posterior aspect of the radius, the skin being held aside by means of blunt hooks. The extensors of the thumb, especially the long, delicate extensor tendon of the distal joint, and the radial artery where it lies on the posterior part of the carpus, require special care for their conservation at this period of the operation. The radial extensors inserted into the metacarpal bones of the index and middle finger need not be preserved, as their points of attachment usually require to be removed in the resection of the diseased parts. The tendons of the common

extensor, and of that of the little finger, are then cleared from the inner part of the radius and groove on the back of the ulna, the edges of the inner incision being held apart to enable the surgeon to do so carefully. In clearing these last-mentioned tendons from the back of the carpus and metacarpus, I direct the assistant who has charge of the hand to bend it backwards to relax the tendons, and then insert my knife under the tendons, where I have cleared them above the wrist, turning the edge of the knife towards the bones, I cut downwards so as to clear the tendons and fibrous textures from the surface of the carpus and metacarpus to the required extent, without risk of division of the tendons. The next step in the operation is to separate the flexor tendons lying in front ; and, from their comparatively loose connections, this is readily accomplished by dissecting close in front of the radius and ulna at the outer and inner incisions, and then with the finger, aided by a few touches of the bistoury, the finger or handle of the knife can be passed between the tendons and the bones, whilst the hand is bent forwards to relax the textures. This having been effected, I pass a double fold of broad bandage between the bones and the soft parts on the back of the wrist, to draw them away and protect them during the section of the bones. I then introduce a straight grooved director (a large straight female lithotomy-staff answers the purpose) between the flexor tendons and the front of the radius and ulna ; along its groove the narrow saw is introduced, and the bones sawn through just above their styloid processes from before backwards, or, if more convenient, the director or a narrow metallic spatula being placed so as to protect the flexor tendons, the section of the bones may be proceeded with from behind forwards. The saw is next applied to the metacarpal bones of the fingers, immediately below their junction with the carpus. In some cases I clear the soft texture from the front of the bones, and then pass the narrow saw across the hand, its cutting edge directed to the metacarpus, and saw them through from before backwards. If an attempt be now made to dissect out the mass thus resected, it will almost certainly fail, or

X require a tedious and not very safe dissection ; but if the mass of the carpus and metacarpus be subdivided into smaller portions, each of these can be removed easily and safely. Accordingly, after having sawn through the metacarpal bones of the fingers, I use the bone-pliers and cut the carpus upwards between the index-finger and thumb ; and again, in the same manner, in the line between ring and middle finger. I then seize the portions so marked out with a pair of strong forceps or hook to obtain leverage, and cautiously dissect the bones from the textures in front. The two internal portions having been removed, it merely remains to deal with the external third of the carpus. If the trapezium appears so far sound that I can leave it or its articulating surface with the thumb, I do so, as the usefulness of the hand is thereby much preserved. If not, then I snip off the articular end of the metacarpal bone, and remove that and the remaining portion of the carpus, and also the ends of the ulna and radius if not previously removed. I also leave the pisiform bone when not diseased, as the attachment of the ulnar flexor is thereby preserved. The resection being thus completed, the tourniquet is relaxed, and all bleeding points secured ; special care should be taken to secure small vessels deeply seated in the palmar region, as they may prove troublesome afterwards by distending the wound. I generally introduce the points of suture without closing them for some hours till all oozing has ceased. The hand and forearm are then placed on a splint so padded as to allow the hand to rest comfortably. Subsequently it is placed on a special splint fitted to the hand ; the splint should be hinged at the wrist, so that after a time passive motion may be used. Of late, instead of bandaging the hand, I fix it with broad strips of adhesive plaster.

LECTURE LXXXII.

Excision of Hip-Joint : Objections to the Operation : Mode of performing it when required—Excision of Knee-Joint by Longitudinal, Transverse, and Semilunar Incisions : Operation : Rules for the Permanent Adjustment and After-treatment of the Limb : Dr. Watson's Apparatus—Excision of the Ankle-Joint : Best Method of performing it.

EXCISION OF THE HIP-JOINT.—I have already expressed my objection to this operation, except in cases of advanced morbus coxarius, in which the parts are attenuated, and where the articular structures are disorganised, and the diseased head and neck of the femur are lying almost loose or partially lax in the cavity of an abscess, or are to be felt through openings from which pus has been discharged. In such cases, by freely laying open the sinuses over or along the posterior aspect of the great trochanter, and extending the incision upwards and downwards, and curving its extremities slightly forwards, or by converting the longitudinal into a crucial incision, by making a short transverse cut across it a little above the great trochanter, and dissecting the flaps from off the bone, the trochanter and upper part of the femur are exposed. The limb is then carried obliquely across the opposite one, so as to render the trochanter prominent. A bold firm sweep of the knife carried from the anterior to the posterior part of the trochanter upon its upper edge, and downwards along the femur for two or three inches, separates the attachments of the gluteal muscles. When these are detached, the surgeon, by carrying the limb still more across the opposite one, and twisting it, will often be able at once to project and dislocate the diseased portion of the bone, so as to enable him to apply the saw and remove the trochanter and head and neck of the femur. If, however, the capsular ligament still exists, so as to require division, the operator should introduce his finger into

the wound, whilst an assistant uses the thigh as a lever to project and twist outwards the head of the femur, and render the capsule tense over it. Insinuating his finger between the upper part of the capsule and the soft parts in front of it, he should introduce the blunt-pointed knife, guarded by his finger, and turning its edge towards the capsule cut directly down upon the projected head of the femur. This will open the capsule, and then the head of the femur will be readily turned out, for the round ligament is usually destroyed by disease; if not, it can now be easily divided, and the section of the bone performed. Any vessels which may bleed are then secured, the acetabulum examined, and the gouge applied to remove all disease that can be removed with safety or without perforating into the pelvis. When all oozing has ceased, the wound is closed by sutures, and the limb either laid on padded wire-splint, kept straight by means of the bracketed long-splint, or the extension pulleys, as in fracture of the thigh; only we must avoid much extension, as our object is merely to keep the limb straight and not to keep it of the full length of the opposite, but rather to afford every facility for osseous or firm fibrous ankylosis at the hip taking place.

EXCISION OF THE KNEE-JOINT has been performed by various methods—1st, The H incision—two lateral incisions over the outer and inner sides of the joint, connected by a transverse incision in front across the patella. 2d, A single longitudinal incision in the axis of the limb, commencing about two and a half or three inches above the patella, and carried down over the centre of the joint to below the insertion of the ligamentum patellæ; the textures being dissected off laterally to expose the joint, allow the ligaments to be divided and the articular ends of the bones to be sawn off. Lastly, A gently-curved incision from one condyle of the femur to the other, passing below the patella, the convexity of the curve corresponding nearly to the upper margin of the head of the tibia; the semilunar flap, so marked out on being dissected up, freely exposing the

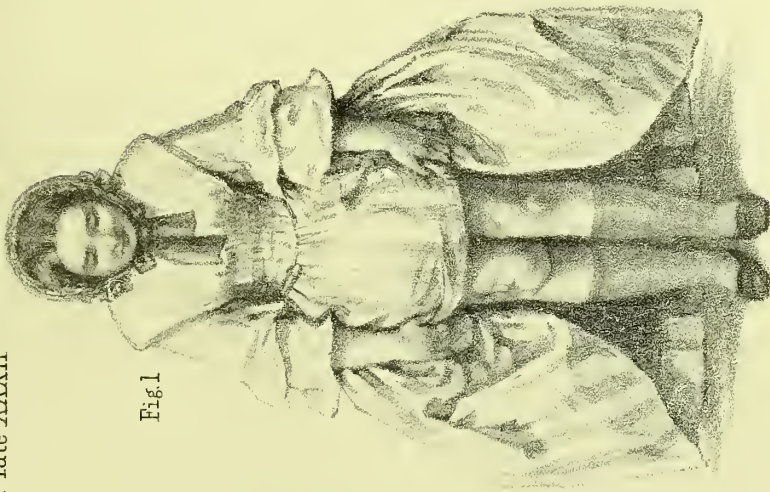


Fig. 1



Fig. 2

articulation for the further steps of the operation. Of these methods, I prefer the last, and it is that which is now almost uniformly adopted in this country. The dissection of flaps and exposure of the textures involved in the method of the H incision are unnecessary, and even hurtful. The longitudinal incision, which I consider the most advantageous in the case of the elbow, has no advantage here, as we do not desire a movable articulation, whilst its form and position favour the retention of blood and serous or purulent discharge in the cavity of the wound.

I shall therefore describe and show you the operation by the lunated incision as I usually perform it. The tourniquet having been applied over the femoral artery, the leg of the affected limb is to be supported by an assistant, seated in front of the patient, the knee being very slightly bent. If the right knee is to be operated on, standing on the inside of the limb I commence my incision over the posterior margin of the outer condyle of the femur, and carry it down to the upper margin of the head of the tibia ; then sweep across the front of the joint at that level, curving my incision upwards over the inner condyle of the femur to a point opposite that where I commenced. If the case be one of articular caries or ulceration of the cartilages, I carry my incision so deep as at once to divide the ligamentum patellæ and anterior part of the joint, and then divide the lateral ligaments ; the semilunar flap, including the patella, is drawn upwards, and the condyles of the femur and tibia separated by bending the knee, so as to expose and facilitate the division of the crucial ligaments. The section of these ligaments should be made by cutting them upon the crest of the tibia, to which they are attached inferiorly, as, by doing so, we avoid risk of injury to the popliteal vessels, which might be injured if we used the knife carelessly at this stage of the operation, especially when the surrounding textures are much altered and disorganised. When the crucial and lateral ligaments are fairly divided, by elevating the femur, its condyles can be projected sufficiently to enable the operator to saw off

as much of the bone as is required. The assistant who supports the leg is desired to project the head of the tibia a little by carrying the foot backwards. The condyloid surface of the tibia is then cleared above the articulation with the fibula. The narrow saw is applied so as to remove a thin slice of the articular surface by sawing from behind forwards. The sharp projecting portions of the section of the femoral condyles are then sawn off or removed with the bone-pliers. The surgeon now applies the sections of the tibia and femur to each other, to see whether their surfaces fit accurately, and examines them to see that all diseased texture is removed. If the patella be diseased it must be dissected off, but if not diseased it should be left. In cases of synovial disease the procedure is somewhat different. The semilunar incision should only divide the skin, fat, and fascia, and be reflected as a flap from the synovial swelling. The whole of the projecting diseased mass, including the patella, is then dissected off from above downwards, and from the sides. Thus the greatest portion of the diseased synovial structure is at once got rid of, and the joint fairly exposed; the lateral and crucial ligaments are then divided, and the other steps of the operation completed as already described. All portions of diseased synovial structure that can be safely dissected off should be removed, and the rest of the surface painted over with the chloride of zinc solution. In excision of the knee, after all the bleeding points had been secured, it used to be the practice to close the wound and put up the limb in the splint. But there is often troublesome oozing from the bone and from small vessels which do not bleed at the time of the operation, and hence I prefer merely to insert some points of suture without tying them, and to place the limb upon a temporary splint. If reactionary bleeding occur, the wound should be re-opened, and permanent adjustment of the limb delayed until twelve, or even twenty-four, hours after the operation. When the bleeding from the section of the bone is very troublesome, I have sometimes found it necessary to interpose a flat pad of lint soaked in a solution of perchloride of iron between the femur and tibia, to

arrest the hæmorrhage. This has usually been quite effectual, the cases going on favourably afterwards.

The permanent adjustment and after-treatment of the limb require great care, with a view to which the selection of proper apparatus is important. In my earlier cases I used to employ the form of splint advised by the late Mr. Price, and the limb was kept fixed, the apparatus resting on the bed. Though the results of these cases were admirable, the treatment was very troublesome; and I feel convinced that for comfort to the patient, and for obtaining a good result with greatest ease, the apparatus should always be swung so that the movements of the trunk may not injuriously affect the limb. Thus the patient can, after a few days, sit up in bed, and bed-sores are prevented. Price's splint is sometimes useful where we want counter-pressure on the sole of the foot, to maintain the tibia in firm contact with the femur in cases where the osseous union is slow in forming.

But, as a general method, I prefer and use, with some slight modifications, the simple and effective apparatus designed by my colleague Dr. Watson. "It consists essentially of two parts—1. A suspension-rod made of iron, about the size of No. V. of trade wire gauge; 2. A modelled Gooch splint, long enough to extend from the tuberosity of the ischium to beyond the heel.

"*The suspension-rod* extends from the groin to the extremities of the toes, and is bent to the outline of the limb, departing from it only in the situation of the excision, where it forms a bow or arch. To the upper surface of the rod are attached one or more hooks by which the suspension is effected."

"*The Gooch splint* should not be made too wide, and should certainly not surround the thigh and leg to more than two-thirds of their circumference. It should be scooped away laterally, at a part corresponding to the site of the excision, and should have an aperture cut corresponding to the tendo Achillis and heel. The inferior extremity of the splint is thus of a horse-shoe or stirrup shape, and admits of the ankle and foot being supported by the lateral horns of the splint, as they fold on each side of the mallcoli, without the risk of inordinate

pressure being made upon the tuberosity of the os calcis. In application, the limb is first laid and carefully adjusted upon the posterior splint, which should preliminarily be padded with lint, and covered with gutta-percha tissue, or hot paraffine, in the situation which corresponds to the site of operation. The iron rod is then placed in front, and folded lint laid between it and the limb at the groin (where the rod terminates above), at the upper part of the tibia, and at the bend of the ankle. These two parts of the apparatus are then retained in contact with the limb by means of an *open-wove* roller bandage applied from the toes upwards, the site of the incision alone being left uncovered. The whole is then rendered immovable by means either of plaster-of-Paris applied by the hand, of a consistence like thick cream, or of paraffine, which, having been rendered temporarily liquid by heat, is applied by a large painter's brush. When the application has solidified, the patient may then be removed to bed, and the limb suspended from the running pulley of a Salter's swinging cradle, or from the roof-bar of the common iron-wire cradle employed to support the weight of the bed-clothes. The foot and limb should not be much raised above the level of the mattress upon which the patient lies, as this is apt to lead to an awkward position of the limb when the patient first begins to move about."

In my own practice I omit the use of the plaster-of-Paris, or at least only use it at certain parts to give firmness and solidity to those points from which the apparatus is to be slung. I substitute broad strips of adhesive plaster in interrupted circles, to fix the apparatus to the foot, leg, and thigh, and then apply an ordinary roller round the foot and leg to a little above middle of the calf, and apply another roller from about four inches above the knee up to near the hip. The pelvic part of the splint is fixed with broad strips of plaster. If there be any tendency to projection or elevation of the condyloid end of the femur, a flat pad should be placed in front, and a separate circle of plaster or broad bandage applied over it and fixed behind the splint. My objection to the plaster-of-Paris bandage

is, that we cannot readily ascertain when deep-seated abscesses may be forming. In three cases in which I used it, everything looked well at and near the wound ; the patients complained of no pain, and it was only after discharge showed itself at the upper part of the apparatus, that abscess, burrowing under the muscles of the thigh, was detected. The modification I recommend allows of the bandage being cut or removed without disturbing the limb, as the broad circles of adhesive plaster retain the apparatus fixed until a clean bandage is applied. Besides, as swelling subsides, the gypsum bandage is liable to become loose and permit of motion between the ends of the bones. I would also advise a water instead of an air pillow as being more comfortable ; but that is a matter of minor importance.

EXCISION OF THE ANKLE-JOINT.—This operation, which corresponds to excision of the wrist in the upper extremity, is, however, much less complicated and much more easily and rapidly performed. The bones which enter into the formation of the joint, are only the lower extremities of the tibia and fibula, and upper head of the astragalus, which last is so defined that its resection can be accomplished without interfering either with the astragalo-scaphoid or calcaneo-astragaloid articulations ; whilst, as regards the tendons and blood-vessels, they are so arranged, and so loosely connected with the bones and joint in front and behind, as to be readily separated and drawn aside, to permit of resection being effected. My own experience of the operation is limited to cases of compound dislocations, in which I consider its performance is preferable to merely reducing the dislocation ; and the ease with which the resection can in these instances be performed proves that in certain cases of disease it might be as easily effected with great advantage. But, unfortunately, the suitable cases are of rare occurrence, as the extent of the disease, and the implication of the surrounding textures, are very generally such as to necessitate amputation.

The best method of performing excision of the ankle is by means of two lateral incisions ; one along the inner and posterior

margin of the tibia, commencing about two or two and a half inches above the internal malleolus, and passing below the malleolus, curving round it and forwards towards the inner margin of the tendon of the tibialis anticus. The other incision is of the same extent and form, along the outer margin of the fibula, and should curve to the peroneus tertius tendon on the outside of the foot. The operator first carefully dissects or separates the tendons of the peronei muscles from the fibula, till he can pass his finger well behind that bone. He then proceeds to separate the tibialis posticus and common flexor from the tibia along the line of the internal incision, and carefully clears the posterior aspect of the tibia and fibula above the joint, so that he can pass a narrow metallic spatula from one incision to the other, between the bones and the soft parts placed posteriorly. The next step in the operation is to dissect forward the skin flaps marked out by the incisions, and separate the tendons, vessels, and other soft parts in front from the joint. In doing this, the edge of the knife should be constantly directed towards bones and joint, to secure the safety of the extensor tendons and anterior tibial artery, and also to disturb the connection of parts as little as possible. When this has been accomplished, a doubled fold of broad bandage is passed behind the soft parts, to enable the assistant to draw them forwards. The foot should now be forcibly inverted, to put the external lateral ligament on the stretch and render the external malleolus prominent: by cutting directly upon the point of the malleolus, from without inwards, the narrow attachment of the external lateral ligament is at once divided. Then, the margins of the inner incision being separated, the surgeon divides the narrow attachment of the internal lateral ligament on the point of the internal malleolus. The joint being thus opened, the foot is replaced, and held firmly at right angles to the bones of the leg. The soft parts are then held forcibly apart from the bones; the long narrow Langenbeck saw is passed between the posterior surface of the bones of the leg and the soft parts, which are protected by the metallic spatula; and the tibia and fibula sawn through from behind forwards,

about an inch above the malleoli. As the malleolar fragments have already been separated from their ligamentous attachments, a few touches with the point of the knife suffice to separate any remaining attachments, and the resected fragments are removed, either by the internal or external incision. As the soft parts are held apart, and the foot fixed, the upper portion of the astragalus comes into view, and the projecting articular portion is sawn off. Should there be any difficulty in doing this, the foot should be twisted, so as to project the astragalus laterally, to allow the section to be made with the narrow saw. All portions of diseased or injured synovial structure should be removed, all bleeding vessels twisted or otherwise secured, and points of suture introduced, and either closed at the time or left to be secured when all oozing has ceased.

When there is much diseased synovial tissue, which cannot be dissected off, the surgeon should paint it over with a solution of chloride of zinc (1 part to 30). The limb is then placed on a light wire-splint, well padded and covered with gutta-percha tissue, secured and slung in the same manner as for compound fracture of the ankle, represented in Plate xvii. Fig. 13, only, instead of bandages, broad strips of adhesive or soap plaster may be advantageously used to secure the limb to the splint, and the use of ice-bags must depend on the circumstances of each case.

LECTURE LXXXIII.

Amputation : Ends sought to be attained by it : Best Modes of fulfilling these—
Anatomy of Stumps—Growth of Bone after Amputation—Advantages and
Disadvantages of various Forms of Flaps, as advocated by Liston, Syme, and
others.

THERE are few operations which the surgeon is more frequently called on to perform than AMPUTATION, and none which require more consideration as to the best methods of operating, more care in the performance, and more attention in the after-treatment. Whilst, on the one hand, the term “Opprobrium of Surgery,” is singularly unsuitable as applied to an operation, which, by removing a disorganised or worse than useless part, so often snatches the patient from the very jaws of death, and restores him to health and comparative enjoyment ; on the other hand, as it is an operation which necessarily entails mutilation, the surgeon is bound to use his utmost endeavours, not only to obviate the causes of danger to life, but also to avoid those conditions which are likely to interfere with the future comfort of the patient. He must not only remove the limb with safety to the patient, but he must also avoid the production of a painful or irritable stump.

The formation of a good useful stump, effected with the least risk to life, being the object in view, the question to be decided is, What methods of operating enable us most surely and readily to attain it ? Having had a very considerable experience in performing amputations, and having, from an early period of my professional life, paid great attention to the subject, I trust the following remarks, founded on the results of my personal investigations and experience with regard to the different modes of operating, may be of some practical service.

In deciding on the advantages or disadvantages of the differ-

ent plans of operating, we must first determine what are the requisites of a "good stump." I believe these may be succinctly stated thus : that the bone be well covered with soft parts ; that it shall not be adherent to, nor bear directly upon, the cicatrix ; that the nerves be so cut as not to become involved in the cicatrix or attached to the end of the bone ; and that they be so deeply covered as to obviate the bad effects produced on their cut extremities by pressure or atmospheric changes. A stump possessing these requisites will be able to bear a considerable amount of direct pressure, without becoming painful, irritable, or liable to ulceration.

Having fixed a standard, I now proceed to consider how far the various methods of amputation reach or fall short of it, and what is the best mode of attaining it. In considering the general principles I shall take the amputation of the lower extremity, and specially that of the lower third of the thigh, as typical of the operation.

When I first entered the profession, the methods of amputation then in general use were, the flap operation by transfixion, and the old circular operation as modified by Alanson. In Edinburgh the former method, characterised by great rapidity in its performance, and strongly advocated by Messrs. Liston and Syme, had so completely gained the ascendancy that I never saw the circular operation performed until I visited the hospitals of London and Paris. There I found most of the leading surgeons keen advocates for its employment, and denouncing the flap operation as being much more dangerous to life, and as leading ultimately to bad stumps. My own observations, tinged perhaps by some prejudices of education, led me to the conclusion that the flap method was decidedly the better ; although a careful examination of results showed me that it did not possess all the advantages claimed for it. The chief objections I had heard urged against the flap operation by the advocates of the circular method, were first, that the redundancy of muscular tissue retained acted as a source of danger ; secondly, that this tissue was useless as a covering, because it became atrophied, and in

course of time disappeared altogether ; and thirdly, that the manner in which the nerves were cut favoured the development of neuromata. With regard to the first of these objections, subsequent experience has shown me that it possesses much force. In order to determine how far the two latter assertions were correct, I made a series of dissections, which included stumps formed by both methods of amputation. Several of these dissections are now in the University Museum, and others in my private collection. As the result of this investigation, I may state, without entering into details, that, whilst the muscular substance retained in flap operations was observed to be diminished in bulk, the decrease in many cases had not occurred at all to the extent which *à priori* reasoning might lead us to expect. Thus, in a flap amputation of the leg, which I dissected twelve years after the operation, the portion of the gastrocnemius covering the end of the bone had scarcely undergone any change ; and in a dissection of a hip-joint stump, three years after the operation, the coarse muscular fasciculi of the gluteus were distinct and of natural appearance up to the very cicatrix ; and in almost every case, the muscular tissue, even when greatly altered in character, could still be traced as a thick fibrous layer under the integument. As regards the presence of neuromata, or enlargements on the extremities of the divided nerves, I found that these were equally present in all forms of stumps, and even when the nerves were deeply covered ; that, in fact, a greater or less enlargement of the end of a nerve was a necessary consequence of its division. From a careful examination, with low magnifying powers, of such neuromata in dissected stumps, and of those which I had removed from stumps in the living, I found that they consisted of consolidated lymph, deposited amongst the fibrillæ of the nerve ; and, as explanatory of their origin, I think it probable, as I stated in a notice of this subject before the Anatomical Society of Edinburgh, that when a nerve is divided the neurilemma retracts to a greater extent than the contained fibrillæ, which, being thus set at liberty, spread out and separate from each other ; that lymph is then effused in the spaces between



Fig. 1

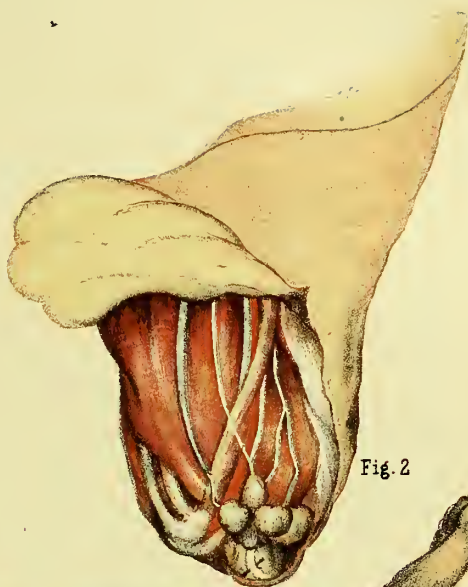


Fig. 2



Fig. 5

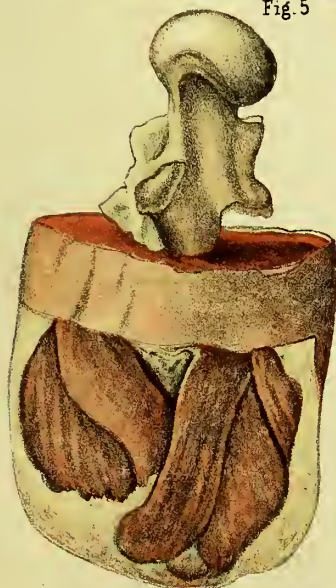


Fig. 3

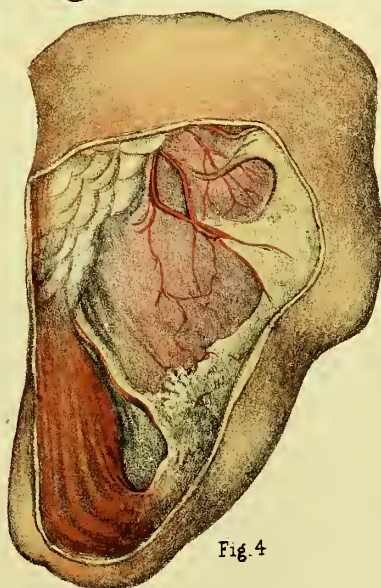


Fig. 4

them, and that the nerve filaments become attached to this lymph, and, as further effusion takes place, are stretched out upon it. When such swellings are subjected to irritation from pressure, or, being near the surface and scantily covered, are liable to atmospheric influence, or when they happen to have become involved in the cicatrix, they increase in size, and give origin to excessively painful symptoms ; but, whether the stump has been a painful one or not, neuromata are invariably present on all the nerves of any size.

I may here also describe the appearances observed in the bones forming the skeleton of the stumps. At the point where they were sawn across, the surface had become rounded off, and the medullary canal was closed in by the effusion of new bone. They were also, in most cases, atrophied so as to appear more than naturally pointed ; but in some instances they were enlarged, either generally or partially, by the deposition of osseous matter. In stumps of the forearm and leg the ends of the two bones were usually approximated and connected by a strong ligamentous substance, and in some cases they had even coalesced so as to form an osseous arch. In almost every instance the end of the bone corresponded to the cicatrix, and was often firmly united to it.

There is an interesting point in connection with this part of the subject, to which I would further allude—namely, the growth of the bone after amputation in young persons, this growth giving rise to projection of the cicatrix and conical stump. Mr. Hargrave of Dublin long ago drew attention to this circumstance in his work on operative surgery ; and my own observation leads me to believe that the bone may continue to grow in the young, and thereby tend to produce the results which have been mentioned, although, doubtless, this condition of stump may also be caused by other circumstances which come into play as the patient grows up. My own dissections do not furnish sufficient data on this point, but I have one preparation of so marked a kind that I cannot but refer to it. The case was one of amputation of the upper arm, performed by Mr. Liston ; and in it not

only does the bone project in an extreme degree, but it terminates in a hook-like process. This could scarcely result merely from the retraction of the other tissues. The practical deduction to which this leads us is, that in performing amputation on the young we should leave rather a redundancy of soft parts, so as to obviate the effects of the osseous development.

These dissections, then, satisfied me, in the first place, that the muscular tissue preserved in stumps formed by the flap operation was useful in providing a thick layer or protecting pad, which did not disappear even after the lapse of many years; and, in the second place, that a certain degree of enlargement of the ends of the nerves in a stump was the inevitable consequence of their division, in whatever manner the operation was performed; the point to be attended to in regard to this being to cut them so high that they could not become involved in the cicatrix, or stretched over or adherent to the end of the bone, and to have them so deeply covered as to be less liable to be affected by atmospheric changes or external pressure.

I was still further induced to give the preference to the flap operation by the condition in which I found those stumps that had been formed by the circular method. Nearly all of them that I examined were extremely conical, and had the bone adherent to the cicatrix, which latter was not unfrequently ulcerated; in the living subject, too, they were almost always excessively tender. At the same time, many of the stumps formed by the flap operation were very defective, and this was especially the case when the amputation had been performed according to the method of Vermale, by lateral flaps in the lower third of the thigh. In such a stump the bone projected towards, and generally adhered to, the cicatrix at the anterior point of transfixion, whilst the soft parts forming the flaps hung back from it. In many cases both of lateral and antero-posterior flap operation I found the soft parts so retracted as closely to resemble stumps formed by the circular method, and in several the bone projected the cicatrix, whilst in others the flaps seemed to have turned in upon themselves, leaving a deep cleft corresponding to

the cicatrix, which was closely attached to the bone. Still, as a general rule, the stumps resulting from the flap operation were decidedly better than those from the circular, and their defects apparently did not depend on causes inherent in the mode of operating; and, on the whole, this method appeared to combine greater rapidity and facility of execution, with the formation of a more thickly-covered stump.

The plan which I adopted in my earlier operations was that by anterior and posterior flaps as recommended by Mr. Liston. The flaps were made by transfixion, the one in front being rather short, whilst the one behind was considerably longer, in order to allow for the greater retraction of the posterior muscles. The flaps were then pulled well back, and the bone cleared by circular sweeps of the knife before applying the saw. Thus, when the operation was concluded, the result was two rounded flaps of equal length, with the bone cut through a little higher up than their bases. Nothing can look finer than this at the time. The smoothly-cut flaps come neatly together, and cover the bone thickly, so as to form a well-rounded stump. Practical experience, however, soon showed me that in order to obtain a permanently well-covered stump, it would not do to trust to flaps formed in this manner, as they had a tendency to retract gradually to the point of transfixion; and if, in order to remedy this defect, they were cut very long, they contracted and turned in upon themselves, and left a deep cleft in the line of the cicatrix, so that the cushion of soft parts did not correspond to or cover the end of the bone. Seeing, then, that merely adding to the length of the flaps did not produce the result which was desired, I was led to make an alteration in the method of operating itself. I transfixed the limb fully two inches lower down than where I intended sawing through the bone, and having cut and retracted the flaps, I applied the point of the knife round the bone so as to clear it upwards to the extent of the two inches already specified. The limb was now raised in order to project the bone away from the soft parts, and the saw was then applied as high as possible. By this means the bone remained deeply covered even

after permanent contraction of the stump had taken place, because, although flaps may retract up to the line of their bases, they cannot do so beyond it, and by such a mode of amputating as has been described the bone was cut through a long way above the base of the flaps.

I still further modified my plan of operating by making the anterior flap the longer of the two, instead of the posterior as recommended by Mr. Liston. That great surgeon, when speaking of antero-posterior flaps in the thigh, urges, as one of their advantages, that "the more the stump is raised, the better is the end of the bone covered—the anterior flap folds over it." Examination, however, has shown me that, in stumps formed according to Mr. Liston's method, the bone is never fully covered by the anterior flap; and indeed it will be obvious to any one, that the mode of balancing the flaps by cutting the posterior longer, so as to allow for its greater retraction, must necessarily make the line of cicatrix pass through the centre of the end of the stump, and so correspond to the extremity of the bone. By cutting the anterior flap, however, rather longer than the posterior, two unequal flaps will result; the anterior will then "fold over the end of the bone," and the cicatrix will be posterior to the centre of the stump. Another advantage which arises from this plan of operating is, the greater simplicity of the dressing and after-treatment, owing to the diminution in the bulk and weight of the posterior flap. I continued to practise the double-flap operation thus modified, and to teach it in my surgical lectures up to a very recent period; and from the results I obtained I was satisfied that it did not leave much to be desired as regarded the form of stump; and in some parts of the limbs, and under certain circumstances, it is that which I still recommend and adopt. It, however, requires great care in its performance, and in some cases is attended with much difficulty. As examples of such cases, I may especially refer to two of not uncommon occurrence—namely, primary amputations, and amputations through condensed textures, as in the vicinity of necrosed bones. In the former, when amputation is performed on a healthy man it is almost

impossible to avoid a redundancy of muscular tissue, and this not only prevents the integuments coming readily together, but also causes the section of the bone high up to be a matter of great difficulty. In the latter the densely consolidated, almost cartilaginous, tissues composing the flaps, cannot be retracted so as to allow the bone to be cleared and sawn through sufficiently far above the point of transfixion, and therefore, in such cases, this plan of operating cannot be properly executed. To get rid of the redundant muscle in primary amputations, and more especially in amputations below the knee, I used to slice off a portion of the muscle after the flap was formed ; and this, although a somewhat awkward-looking procedure, made a better stump.

In 1846, Mr. Syme, whose writings and practice had done so much to introduce and promote flap amputation in this country, took occasion to state, in a paper on amputation of the thigh (*Edinburgh Monthly Journal of Medical Science*, 1846), that his experience had led him to modify his opinion as to the advantages of flap amputation, and to recommend as preferable, in the lower third of the thigh, a modification of the circular method. This consisted in making two semilunar incisions through the integuments, which are dissected and retracted upwards for at least two inches, then cutting the muscles on a level with the retracted skin obliquely up towards the bone, the muscles on the posterior aspect being divided somewhat lower down than those on the anterior. All the soft textures are then forcibly retracted, and the bone cleared and sawn high up. This plan of operation, when it is well performed, and when care is taken to leave a sufficiency of soft parts, gives excellent results, and is especially applicable to primary amputations. I have repeatedly operated by this method in such cases, and also in others ; and although at first prejudiced against it, I have no hesitation in saying, that in primary cases at least it is superior to the ordinary double-flap operation by transfixion, both as involving less risk to life, and as forming a better stump. In several cases, also, I have practised the ordinary circular amputation with the same successful results. But whilst I was thus

led to recognise the advantages of the circular, or modified circular, method in primary and certain other amputations, yet in ordinary cases of disease of the knee, where the muscular tissue was not redundant, I continued to practise the modified double-flap operation formerly described, because where the circular method was employed, the muscles, owing to the way in which they were divided, retracted and did not heal over the end of the bone. The only covering for the stump, therefore, was the skin and subcutaneous fatty layer, which latter, in cases of chronic disease, is apt to be very scanty. Mr. Syme, indeed, supposes that there is a mistake in regard to preserving muscular tissue, and thinks that skin is the proper covering for a stump. In the paper already referred to he says—"The perfect condition of stump resulting from amputation at the ankle, where there is nothing but integument to protect the bone, led me to conclude, that if the circular operation could be performed with the certainty of producing such a covering, it might be employed with advantage in the lower third of the thigh, which being the thinnest part of the limb, more readily admits of forming a stump composed merely of skin." There is, however, a fallacy in this, arising from the idea that in the ankle-amputation there is nothing but integument to protect the bone. The protective covering in that amputation is altogether peculiar, consisting as it does not merely of skin and ordinary subcutaneous fat, but of a peculiar elastic cushion of fat and fibrous tissue, specially arranged and adapted by nature for bearing direct pressure. If indeed we could, as Mr. Syme observes, obtain such a covering in other situations, it would undoubtedly be superior to all others; but unfortunately, in no other amputation can we obtain it; and as the dissections of old stumps have shown me that the muscular tissue retained does form a protective covering more or less thick, I still think that if we can preserve it in moderate amount, and in such a position as fairly to cover the end of the bone, we shall then have a better stump than when we trust entirely to skin.

LECTURE LXXXIV.

Amputation continued—Mr. Teale's Method, by a Long Anterior and Short Posterior Flap : its Advantages and Disadvantages—The Author's Method, by Long Anterior Flap—Mr. Carden's Method.

IN 1858 the late Mr. Teale of Leeds published an account of his method of amputation by a long and a short rectangular flap. The mode of performing the operation, and the objects proposed to be attained, may be given in Mr. Teale's own words. "To procure a more useful stump, and in the hope of somewhat diminishing the mortality of the operation, it is proposed to amputate by a long and a short rectangular flap ; the long flap, folding over the end of the bone, being formed of parts generally devoid of large blood-vessels and nerves, whilst these important structures are contained in the short flap.

"The size of the long flap is determined by the circumference of the limb at the place of amputation, its length and its breadth being each equal to half the circumference. The long flap is therefore a perfect square, and is long enough to fall easily over the end of the bone. In selecting the structures for its formation, such parts must be taken as do not contain the larger blood-vessels and nerves. A flap so formed will be, for the most part, anterior in position, as far as regards the general aspect of the body, but superior when the patient is in the recumbent position, as during the after-treatment. The short flap, containing the chief vessels and nerves, is in length one-fourth of the other. The flaps being formed, the bone sawn, and the arteries tied, the long flap is folded over the end of the bone ; each of its free angles is then fixed by suture to the corresponding free angle of the short flap. One or two more sutures complete the transverse line of union of the flaps. At each side the short flap is united to the corresponding portion of the long one by a

point of suture, and one suture more unites the reflected portion of the long flap to its unreflected portion. Thus the transverse line of union is bounded at each end by a short lateral line at right angles to it."

Before investigating the merits of this method, we may observe that amputation by a long anterior and a short posterior flap is not a new operation. In 1765 Mr. O'Halloran of Limerick recommended, and carefully described, such a method for amputation of the thigh. His directions are as follow :— "With a straight knife commence your flap incision at about three inches more anteriorly (lower down?) than where the bone is to be sawn through, supposing an adult, and so in proportion to the age of the patient and the size of the limb. Let the incision be continued in an oblique direction till you reach the bone, then, with the same, or a common amputation-knife, make your circular sweep, commencing from the side of your flap, directly to the bone." Mr. O'Halloran, however, had peculiar views as to dressing his stumps. He inserted a piece of lint between the bone and the flap, dressing the surfaces separately for ten or twelve days before approximating them. In 1848 this method of amputation was revived in France by M. Sedillot, and also by M. Baudens; the former surgeon, even in his mode of dressing, closely following O'Halloran, by directing a piece of lint or other digestive to be interposed between the bone and the flap for some days. On consideration it will be seen that the anterior flap, recommended by Mr. O'Halloran, is far too short. For, taking the thigh as nearly a circle, and 12 inches as an average circumference, the flap would be less by 1 inch than the diameter of the limb, or the surface which it has to cover. This, along with the peculiar mode of dressing the stump, was probably the cause of the operation falling into disuse.

Mr. Teale's method of amputation possesses the great advantage of having the end of the bone completely covered by the sound tissue of the anterior flap, whilst the cicatrix is placed high up on the posterior aspect of the stump. It, however, has certain disadvantages. The excessive length and square

form of the anterior flap are, in themselves, serious drawbacks to the operation. Moreover, as the angles of the anterior flap require to be brought into exact apposition with those of the posterior, the anterior flap must be doubled on itself. When retained in this position by stitches, its vitality is placed in some risk, and, if union by first intention do not occur, the reflected portion of the flap is apt to fall away from the unreflected portion, thereby causing trouble in the after-dressing of the stump.

In 1858 I began to practise a mode of amputation which has yielded excellent results, and which in certain situations, as for example in the lower third of the thigh, I now employ in preference to any other operation that I have hitherto tried. The method which I adopt is that of a long anterior flap, but this is formed on a principle essentially different from that which regulates the construction of the flap in the operations of O'Halloran, Sedillot, and Baudens, and is a material modification and simplification of Mr. Teale's method. In carrying out the directions of Mr. Teale, it is absolutely necessary, as was previously observed, that the angles of the anterior flap be brought into exact apposition with those of the posterior. The anterior flap must, therefore, be doubled on itself, and in order to admit of this its length must be equal to one-half of the circumference of the limb, so that in a thigh twelve inches in circumference, if we do not obtain an anterior flap at least six inches long, the operation cannot be accomplished. In the method of amputation which I employ, the anterior flap is not formed with the design of being doubled on itself, but is simply made of such a size and shape as will allow it to fold loosely over and cover the posterior segment of the stump. For this it is necessary that the flap, throughout its extent, be in breadth fully equal to one-half the circumference of the limb, and that it be gently rounded at the extremity, so as to adjust readily to the curve of the cut margin of the posterior half of the stump, whilst it must be sufficiently long not merely to cover, but to hang loosely over, the posterior cut surface, so that the cicatrix may be placed ulti-

mately on the posterior aspect of the thigh, and without the flap being tensely stretched over the end of the bone. In my own operations I judge of the proportion by the eye, but a flap of four inches would be found sufficient in a limb twelve inches in circumference. The soft parts on the posterior aspect of the limb are divided obliquely towards the bone, the incision beginning two inches lower than the level of the base of the anterior flap. Due attention must be paid to the mode of preparing the bone for section. The thigh should be somewhat elevated towards the pelvis, the soft parts retracted, and the bone cleared two inches higher up than the base of the flap. By elevating the thigh, the bone is projected to the utmost, and if sawn close to the soft parts, it will be found, on the limb being lowered, to be deeply buried, and the anterior flap hangs loosely over it.

In regard to the textures composing the flap.—I generally operate as low down as possible, the lower margin of the anterior flap being on a level with or below the patella, so that the lower part of the flap is chiefly composed of skin; but then I cut obliquely upwards through the anterior muscles to the bone, so as to have a thicker cushion of texture directly corresponding to the sawn end of the bone. Lastly, the great vessels must be left in the posterior part of the stump, and not included in the flap. Keeping these points in view, the operation may be briefly described thus:—Supposing that the right thigh is to be amputated, the surgeon, standing on the inner side of the limb (so as to be able to grasp the distal portion of bone when sawing), inserts his knife deeply, pretty far back on the outside of the thigh, and about three inches above the patella. He then carries the knife downwards through the skin and fascia to a level with the lower edge of the patella, and after cutting, with a gentle curve, across the front of the limb, he carries the incision up the inside of the thigh, to a point opposite the place where he commenced it. Whilst he is making the incision, his assistant retracts the skin and fascia, and when, by a few touches with the knife, the muscular tissue of the thigh is exposed, the surgeon cuts obliquely through it to the bone so as to dissect up

Fig. 1

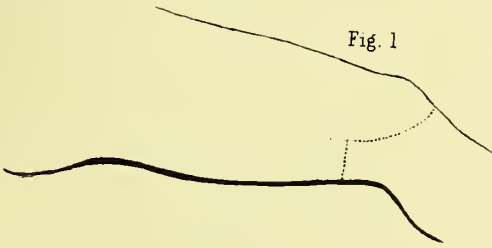


Fig. 2

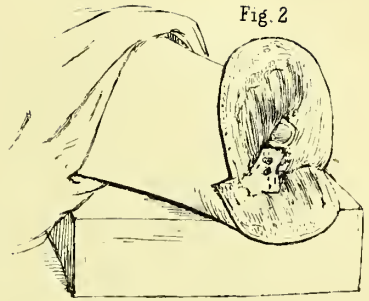


Fig. 3

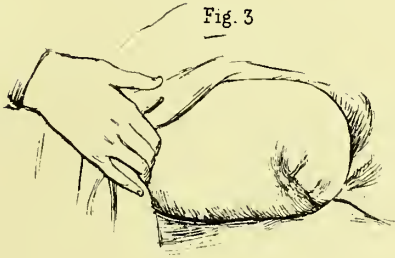


Fig. 4

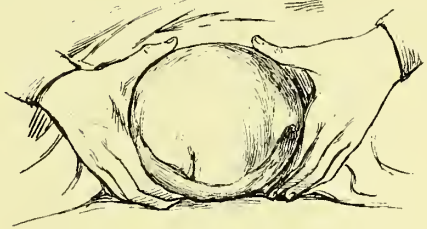


Fig. 6



Fig. 7

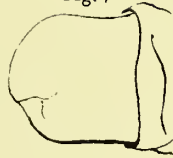
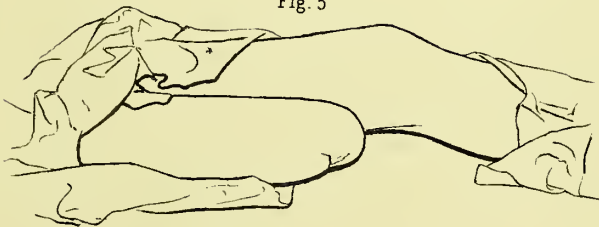


Fig. 5





the flap from the femur ; then applying the edge of his knife to the soft parts on the posterior aspect of the limb at least two inches lower than the level of the base of his flap, he cuts them with a sweep obliquely to the bone. The assistant next retracts the soft parts, whilst the surgeon clears the bone for nearly two inches with a circular movement of the point of his knife. The femur then being elevated so as to project it fully, is sawn through close to the soft parts, immediately above its condyloid portion. The femoral artery is very easily seen towards the inner side of the posterior section of the stump, and when it and other bleeding vessels are secured, the flap is allowed to fold over the face of the stump, and is then adjusted and retained by sutures.*

This plan of amputation possesses all the advantages of Mr. Teale's method, without requiring the troublesome adjustment of the angles of the square flaps, or the doubling back of the anterior flap upon itself. Nor does the anterior flap require to be of the excessive length which is necessary in that surgeon's operation. The after-dressing is also simplified, for if union by first intention does not occur, the flap, by its own weight, naturally tends to keep in position. Another important distinction consists in the bone being sawn through higher up than the base of the flap. It may appear, at first sight, that cutting a flap four inches long, and then making the section of the bone two inches beyond its base, is simply equivalent to making a flap six inches in length. But it is not so. A flap, however long, does not afford that deep, permanent covering, which results when the bone is buried amongst the textures, beyond the base of the flap, after being cleared by Alanson's method, whilst the cut surface exposed is also less.

In 1863, Mr. Carden of Worcester published an account of his method of amputation by single anterior flap, composed entirely of skin. The form and position of the flap are very similar to those of my method, but the base of the flap is not quite so high up, as Mr. Carden saws through the condyles of the femur, and, as I have said, the flap is composed entirely of

* See Plate xxxiv.

skin. I have performed several operations by this method, and seen many stumps formed by it, but these have all been decidedly inferior to those formed either by Teale's operation or my own, being wanting in thickness of soft parts over the end of the bone. In some cases I know the bone has caused ulceration of the part of the flap corresponding to it, and consequent adhesion to the bone. In some cases, also, I believe, great trouble has been caused by continued oozing, and even smart hæmorrhage, from the cut surface of the condyles; whilst, from what I have seen, I do not think the results show this method to be less dangerous to life than the other, in which the bone is sawn through immediately above the condyles, and a moderate amount of muscle preserved to form a protective cushion for it.

In a paper on amputation by Professor Lister, in Holmes' *System of Surgery*, I observe that in speaking of my plan of amputation, whilst he admits some of its advantages, he seems to think that it still involves the necessity of amputating higher in the thigh in order to procure a sufficiently long anterior flap. Now, what I consider to be one of the great advantages of the operation is, that it enables us to amputate lower in the thigh than we can do if we employ the double-flap method; for, as that part of the flap which is to be behind the bone does not require to contain muscular tissue, we are enabled to cut the flap as low down as below the margin of the patella.

Although convinced of the advantages of the single-flap operation at the lower third of the thigh, I would not sacrifice any extent of the limb merely to obtain a long anterior flap; and, as Professor Lister had seen several of my cases, he might have noticed that the stumps were all much longer than when made by the ordinary flap method. The method which Mr. Lister proposes of an anterior flap somewhat longer than usual, and a shorter posterior flap, is in fact my modification of Liston's double-flap operation, which I had long taught and practised, and which, in a previous part of these lectures I have fully described. This modification I still prefer in certain cases, but, after considerable experience of both plans, I have abandoned it,

as a general rule, in favour of the method by a single anterior flap.

In other amputations, as in those of the arm and forearm, whilst the single flap may be adopted, it has fewer advantages. From the form of the limb, and its position when the patient is lying in bed, the flap does not adapt itself, by its own form and weight, to the cut surface, but, being placed more or less laterally requires to be retained in position. In these situations a modification of it answers sufficiently well. In the upper arm a stump formed by a single flap from the outer and anterior aspect of the limb, the inner aspect being divided circularly a little below the level with the base of the flap, possesses the advantage of having the great nerves divided high up and so removed from the end of the bone, which is covered by a good cushion of soft parts. The cicatrix is also placed high up on the inner side, beyond all risk of pressure. In amputation at the shoulder-joint, the method I prefer is also that by a single flap, cut in a particular direction. As a general rule and for the reasons already advanced, I consider the single flap preferable, as forming a better covering of sound textures, and removing the cicatrix from pressure ; but in certain amputations, and in particular circumstances, a modification of it, or two equal flaps, may answer better. Thus, in cases of amputation for malignant growths, I would advise the modified circular method, or two equal short flaps principally composed of skin, because in such cases we desire to avoid having any part of the flap cut from near the tumour, and the muscular tissue should be largely removed, being liable to contain proliferous cells, even at some distance from the growth, and a long flap of skin, from which the subjacent muscles have been dissected, has its vascular supply impaired, and is very apt to slough. Again, in certain situations, as in some amputations of the foot, the position of the cicatrix in reference to the direction of the pressure of the boot, requires to be considered ; and finally, I need hardly remark that in cases of injury we cannot select our method of operating, but must modify it according to circumstances.

LECTURE LXXXV.

Amputation continued—Prevention of Hæmorrhage during the Operation, and its arrestment afterwards—Immediate and After-treatment of Stumps.

As regards the arrestment of hæmorrhage in amputation, we have, first, to attend to the temporary bleeding during an operation; and, secondly, its permanent arrestment after the operation.

In the great amputations in private, and also in hospital practice, the ordinary tourniquet is the safest instrument for arresting bleeding during the operation. At one time this method was objected to as entailing a larger loss of venous blood than necessary; but this is more a theoretical than a practical objection, for if the ordinary surgical tourniquet be put on properly, and not screwed up till that is done completely, no great loss of venous blood will take place. If it be screwed up partially, the veins will become congested, and so venous hæmorrhage will take place; but in that case the fault is in the method of using it, and not in the instrument itself. There are various tourniquets in use; some are made so as to compress only two points of the limb—namely, over the main artery and a point directly opposite—these instruments control the flow of blood through the main channel, but allow the intermediate collateral circulation to be carried on, and are therefore not so good as the common one. In an œdematous limb the tourniquet is very apt to get slack as the serous fluid escapes, and we should therefore be careful, if the serum escapes rapidly, to tighten it so as to prevent any loss of blood. It is better to compress the main artery by means of the fingers, if we have a good assistant, for this does not interfere with the retraction of the muscles. When the tourniquet is used, the muscles are prevented from retracting to their full extent at the time, and on

removing the tourniquet they retract very quickly, and we find that the bone projects more than we expected, so that an assistant's fingers are the best compressors we can have. In the case of the femoral artery, the compression should always be on the brim of the pelvis, and never on the femoral artery in the thigh, for by the former method we get complete command over the vessel. The brachial artery should always be compressed very high up, just where the axillary artery ends, no matter at what part of the arm we are going to amputate, because the brachial artery in the middle of the arm is very movable; and if it slips from under the assistant's fingers, it is often difficult to get it compressed again.

The permanent arrestment of hæmorrhage, is effected in the usual way, by ligature or by acupressure. In using the ligature the vessels are drawn out and tied close to the soft parts; the loop of the ligature should always be passed over the point of the artery forceps before being at all tightened, and the vessel should be tied as far from the forceps, and as near the soft parts of the stump as possible. If any small branches are seen coming off from a large artery, the vessel should be dissected up a little, and tied above the point where the branches come off.

The after-treatment of the stump may be said to be the same as that of an incised wound, though practically it is not a simple incised wound, but a very large cut surface, including all the various soft textures of the limb, and having at its deepest part either a section of the bone or an articular surface. When we reflect on the various degrees of vitality, and therefore of reparative power, in the different textures forming the stump, we can scarcely expect all these textures to heal exactly in the same time or in the same way. Those endowed with much vitality, such as the skin, cellular tissue, and muscles, are generally united very soon, while the tendons and the osseous textures are undergoing slower processes of healing and alteration in form. In the case of the denser and less highly vitalised tissues, the amount and extent of action which follows the operation, whilst it may not be excessive for the softer tissues, may

yet prove too much for the vitality of the denser textures ; and portions of fascial or tendinous tissue, instead of healing, may slough. The bone too requires to be rounded off, and during that process, in a very dense bone or after primary amputation, we may have slight molecular necrosis taking place, and abscesses forming from time to time as these minute portions separate. Great exfoliations of the bone are not very common now-a-days, and even acute necrosis, after primary amputation, is not very frequent, but slight molecular necrosis is not uncommon from the bone rounding off ; its denser texture, instead of opening out and yielding, dies under the excited action ; there is, in fact, a slower process of alteration and healing in the denser than in the softer textures.

Again, as regards the state of the parts in which we amputate. When we amputate for a diseased knee-joint, for example, we very often have to cut through abscesses and other textures, which are so far unhealthy, and which cannot, therefore, be expected to heal by the first intention. Absolute and complete primary union cannot, therefore, be often expected, but, under ordinary circumstances, we find that a very large proportion, if not the whole, of the stump does heal by adhesive action, portions here and there not being so united, and this is generally due to the character of the textures entering into its formation.

The simple plan of dressing incised wounds was first applied by Mr. Liston to the treatment of stumps. His rule used to be to tie the vessels and wash the flaps, laying the latter in contact ; the patient was then removed to bed, and cold water was applied upon the stump for six or eight hours, till the oozing ceased and a layer of lymph was thrown out on the surface, then the edges of the wound were brought together by sutures. The object of this was to get rid of all oozing and clots of blood, and to let the surface of the wound glaze by effusion of lymph ; the plastic surfaces were then brought together, and the water-dressings were continued, along with slight compression by a bandage. This plan looked very well in theory, but in practice it did not

answer. It was found that the stumps did not heal readily ; the flaps, lying loose, were disturbed by every movement of the limb, and this caused more oozing than would otherwise have happened. This plan was, therefore, soon given up, as it was found to be very inconvenient. The application of cold was beneficial, no doubt, but this should never be carried beyond a certain point, as it may induce a low form of inflammation in the stump, unless it be applied in the form of dry cold by means of ice, which seemed to answer well in the practice of Langenbeck and others, in the late war in Schleswig-Holstein.

In the double-flap amputation, a broad pad of lint is placed in front, and another behind ; a piece of lint is also applied loosely on the surface of the cicatrix, and a bandage is applied so as to prevent any movement. A small part of the wound is always left open at the most dependent point, to allow the blood and serous discharges to escape. At one time there used to be a great dispute regarding the form in which the edges of the stump ought to be brought together. It was disputed whether in the circular amputation the wound should be brought together perpendicularly or transversely ; the advocates of the former view showed that by this plan, when the stump rested on a pillow, the lower part naturally tended to be pressed upon, and so the fluids from the stump could escape readily, while, if the opening were transverse, there was no ready escape for the matter. The fact is, that both in the circular and double-flap amputations, when the cicatrix is transverse, the wound lies obliquely, owing to the form of the limb, so that in reality there is a dependent opening at one side, just as much as if the line of incision were perpendicular. The method of after-treatment I employ is to wash the surface of the wound immediately with cold water, and clear out all the clots of blood. In amputation through diseased textures, as scrofulous joints, or if the remains of the pyogenic membranes of abscesses were present, then I used to apply carbolic acid in methylated spirit to the stump ; but I have given this up, as I have found more benefit from the use of tincture of iodine. This destroys the pyogenic membrane, and prevents

suppuration from taking place to a great extent, so much so, that I used also to apply it to healthy flaps, with a view to prevent great suppuration. The solution of chloride of zinc I have also used with advantage, and still use it after amputations for malignant tumours, but it is often too irritating, unless used weak; still I now prefer it or the iodine to any other local application, though, in most cases, it is best to avoid all such remedies. Having cleansed the wound and arranged the ligatures, I next bring the flaps into contact with sutures, about an inch apart. The parts should be held in accurate apposition as we put in the stitches, and we should begin either in the centre or at one of the angles of the stump.

Cold-water dressing is to be applied to the surface of the stump for about six or eight hours, but after that time I would leave off all moist dressings. If, when the wound is healing, we apply water-dressings to it, with gutta percha tissue over the lint, we are just applying what will act as a poultice, and break up the newly-formed cicatrix. The stump should be placed on a soft pillow, with a sheet of gutta-percha under it, and a piece of dry lint laid over the surface like a veil, and then a wire cradle placed over it to keep off the weight of the bed-clothes. In many cases, indeed, we may dispense with the dry lint, and leave the stump without any dressing, and merely covered by the bed-clothes. In the double-flap and circular amputations we require to place pads of lint on the stump, so as to keep the surfaces together; but in the single-flap operation the flap remains naturally in position.

No attempts should be made to force the union of the stump. If we attempt to force the union by compression, instead of advancing we are very likely to hinder it, and to cause strangulation and gangrene at certain parts of the stump. Long ago different forms of apparatus—plates of metal or wood—were used for keeping the surfaces of the flaps in very accurate contact, and preventing blood collecting between the flaps; but this only serves to irritate the parts, and is therefore to be avoided.

THE CONSTITUTIONAL AFTER-TREATMENT must be conducted on the general principles already laid down in regard to the after-treatment of all great operations, modified, of course, in individual cases by the peculiarities of the case, or the idiosyncrasy of the patient.

LECTURE LXXXVI.

Amputation continued—Causes of Mortality—Statistics—Circumstances modifying the Value of the Information derived from them—Table exhibiting the Results of Author's Practice—Comments on and Deductions made from them.

THE consideration of the causes of the mortality after amputation is a subject so wide, that I cannot be expected to enter on it in all its phases fully in a course of lectures such as this, where so many subjects demand our attention. I will, therefore, confine myself to treating of it from certain points of view, which, from my own experience, I believe to have practical bearings.

Of late years much has been written on this subject, and large statistics have been published, from which certain general deductions may be drawn ;—the most usual deduction being that amputations of the limbs are very dangerous operations, and those of the lower extremity specially fatal.

Now, for my own part, I cannot see any great benefit to be derived from this kind of information, unless it be intended to indicate the propriety of abandoning the operation. However desirable it may be to possess the data established by such statistics, I think it might have been predicted, that in such an operation as amputation, an operation of last resort, and performed often under most unfavourable circumstances, the mortality would be great ; and yet I should think such considerations would not deter any man of sense and experience from performing an operation which gives the only reasonable chance for life. But what I do consider to be of practical importance is to ascertain how far the operation in itself is necessarily of great danger, or whether the dangers are greatly due to circumstances under which it is performed. It is quite possible that the statistics of an operation not dangerous in itself may show results very startling in regard to the amount of mortality attending its performance, due to the circumstances

under which it is performed. The operation for strangulated hernia is an example of this. That operation is, I believe, attended with no danger in itself: the causes of death are invariably to be found in the state of the abdominal viscera antecedent to the operation; and the tables of mortality are swelled by undue delay in operating. The same thing, indeed, cannot be said of amputation, for it has inherent dangers; but I believe many circumstances which determine the favourable or unfavourable result are to be found in the different circumstances under which it is performed.

The statistics of amputation have been rendered of practical service in reference to the question of primary and secondary amputations, because they have been made comparative; and the results have established this great practical fact, that however great the mortality may be in primary amputation, delay in similar cases of injury, with a view to secondary amputation, is still more fatal. Hence the surgeon feels that, when the case is one presenting no reasonable chance of recovery without amputation, he gives his patient the best chance by performing the operation at once. Little, however, has been hitherto done in comparing the immediate results of amputations performed for different diseases. Indeed the usual tabulated form in statistics of amputation is, *Primary, Secondary, and for Disease*; and thus, I believe, much valuable information is lost. Moreover, I think that more useful information would be obtained from statistics of the results of the practice of individual operators, with remarks as to any peculiar circumstances in the cases, and stating the nature and site of the injury or disease for which the amputation was performed, than from the larger general statistics at present referred to. It may be objected that the experience of any one man is too small for purposes of generalisation, but the aggregate of such statistical returns would give the general result—the operative procedure by the same surgeon would give equality in that respect; whilst we would obtain details which, I believe, would have most important effects on practice. In my own practice, both in hospital and private, I have kept such a record

of the greater amputations which I have performed, and I shall now use it in trying to ascertain, or at least suggest, what are some of the causes influencing the results of amputation. My experience in performing amputation, though necessarily small in comparison with general statistics, is yet, I think, sufficiently large to entitle me to form some opinions on this subject; and I give them to you, along with some suggestions to assist you to elaborate the subject more fully with your own experience in practice hereafter.

The following tables exclude all amputations of less magnitude than those at the wrist and ankle joints. The first or general table gives the results of 403 amputations for all causes, and the information it affords is of the usual kind—namely, that out of a given number of cases of amputation so many recover and so many die. The subsequent tables show the results of the different amputations I have performed, under the heads of primary, secondary, and for disease, the last head being subdivided so as to indicate the results of the operation in different diseases, and according to the situation of the disease. A glance at the results of amputations performed for different forms of disease will suggest the object I have in view, to try to ascertain the probable causes of the greater mortality in certain cases, and how far these dangers are avoidable, or may be lessened.

TABLES showing RESULTS of AMPUTATION.

TABLE I.—GENERAL RESULTS.

LOWER EXTREMITY.	Total.	Recovered.	Died.
Hip-Joint . . .	9	3	6
Thigh . . .	155	100	55
Knee-Joint . . .	1	0	1
Leg . . .	53	37	16
Ankle . . .	82	76	6
	300	216	84

UPPER EXTREMITY.		No.	Recovered.		Died.
Shoulder-Joint	.	23	...	17	6
Arm	.	33	...	21	12
Forearm	.	43	...	35	8
Wrist-Joint	.	4	...	4	0
		103		77	26
Total Upper Extremity	.	103			
„ Lower	„	300			
		403		293	110

TABLE II.—RESULTS in relation to Injuries or Diseases for which the Operation was performed.

STATISTICS OF AMPUTATION—LOWER EXTREMITY AT HIP-JOINT.

		No.	Recovered.	Died.
INJURY.	{ Primary	5	1	4
	{ Secondary	0	0	0
DISEASE	{ Malignant Tumour of Femur	2	2	0
	{ Malignant Tumour of soft parts	1	0	1
	{ Chronic Disease of Neck of Femur	1	0	1
Total of Hip-Joint		9	3	6

AMPUTATION OF THIGH—INJURY.

PRIMARY	.	20	6	14*
SECONDARY..	{ Burns	3	2	1
	{ Acute Necrosis after fracture	2	0	2
	{ Gangrene (Traumatic)	4	1	3
		29	9	20

DISEASE.

Disease of Knee-Joint	.	79	67	12
Necrosis and Secondary Disease of Knee-Joint	.	13	8	5
Acute Necrosis of Femur (Idiopathic)		8	1	7
Necrosis of Shaft of Femur	.	6	4	2
Carry over	.	106	80	26

* The causes of death in the 14 fatal cases were—In 7 Shock and Hæmorrhage; in 2 Gangrene; in 5 Pyæmia.

	No.	Recovered.	Died.
Brought over	106	80	26
Repeated Hæmorrhage after removal of			
Necrosed Fibula	1	1	0
Malignant Tumours of Femur	11	5	6
Malignant Tumours of Tibia	3	3	0
Erectile Tumour of Leg	1	0	1
Gangrene in Diffuse True Aneurism	1	0	1
Large Strumous Ulcers of Leg	3	2	1
	<u>126</u>	<u>91</u>	<u>35</u>
Total of Thigh	155	100	55

AMPUTATION AT KNEE-JOINT.

PRIMARY	1	0	1
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LEG.

	No.	Recovered.	Died.	
INJURY . . . { Primary	28	15	13	} Railway and cart accidents.
{ Secondary	3	1	2	
DISEASE	22	21	1	

ANKLE-JOINT.

INJURY	{ Primary	4	3	1
	{ Secondary—Gangrene	1	1	0
	{ Contraction } from Burn }	1	1	0
DISEASE		<u>76</u>	<u>71</u>	<u>5</u>
Total		82	76	6

UPPER EXTREMITY—AMPUTATION AT SHOULDER-JOINT.

FOR INJURY.

PRIMARY	{ Gunshot wound	1	1	0
	{ Railway Injuries	8	4	4
	{ Machine Injuries	6	5	1*
	{ Waggon-wheel passing over Arm	1	1	0
SECONDARY . —Effects of Burn		<u>2</u>	<u>2</u>	<u>0</u>
Total		18	13	5
DISEASE	{ Subclavian Aneurism	1	1	0
	{ Malignant Tumours	4	3	1
Total Injury and Disease		<u>23</u>	<u>17</u>	<u>6</u>

* Secondary Hæmorrhage.

ARM—FOR INJURY.

		No.	Recovered.	Died.
PRIMARY . . .	{ Gunshot	2	1	1
	{ Railway	6	2	4
	{ Machine Injuries . . .	4	3	1
	{ Compound Dislocation of			
	{ Elbow and Fracture . .	1	0	1*
	Total	13	6	7
SECONDARY .	{ Traumatic Gangrene . .	3	2	1
	{ Necrosis after Injury of			
	{ Forearm	1	1	0
	{ Effects of Burn	3	2	1
	{ Gunshot wound of Hand	1	1	0
	{ Machine Injury of Hand			
	{ and Forearm	1	0	1
		9	6	3
Total for Injury—Primary and Secondary		22	12	10

ARM—FOR DISEASE.

Osteo-Sarcoma of Forearm	1	1	0
Strumous Disease of Elbow and Forearm	8	7	1
Results of Erysipelas	1	1	0
Acute Necrosis of Humerus in a			
Child	1	0	1
Total for Disease	11	9	2
Total Injury and Disease	33	21	12

FOREARM—FOR INJURY.

PRIMARY . . .	{ Machine Injury	21	18	3
	{ Gunshot do.	6	5	1
SECONDARY .	{ Traumatic Gangrene . .	1	1	0
	{ For Sloughing of Flaps			
	{ after Wrist Amputation	1	1	0
Total Injury		29	25	4

* A woman of intemperate habits, ætat. 70.

FOR DISEASE.				No.	Recovered.	Died.
Erectile Tumour	.	.	.	1	1	0*
Disease of Carpus	.	.	.	12	9	3
Epithelial Cancer	.	.	.	1	0	1
				—	—	—
				14	10	4
				—	—	—
Total Injury and Disease				43	35	8

WRIST.				No.	Recovered.	Died.
Primary	.	.	.	3	3	0
Disease	.	.	.	1	1	0
				—	—	—
				4	4	0

As to primary and secondary amputation, as I have said, so much has been done by comparative statistics, that I shall merely advert briefly to some circumstances which, in my opinion, cause the great mortality attending primary amputation.

The general conditions which most evidently determine the unfavourable issue are—shock, loss of blood, gangrene of the stump, or pyæmia; and, from my own experience, I would add the co-existence of other lesions, not in themselves very dangerous, and great comminution, especially longitudinally-fissured fracture of the bone or bones through which the amputation is performed; and, lastly, certain moral causes reacting on and depressing the physical powers.

Shock, or that peculiar effect of injury on the vital powers, mental and physical, with tendency to collapse, though difficult to define, is only too obvious in most cases of injury requiring amputation, to be overlooked as a condition unfavourable to the result, whether by depressing the vital powers so that reaction does not take place, or from the effects of over-reaction in a patient whose vital powers are for the time diminished. It may be accompanied and aggravated by hæmorrhage; but even without any loss of blood, the effects induced by the shock on the nervous system are always marked by extreme depression and

* In an infant six weeks old, amputated in consequence of hæmorrhage from the tumour.

collapse, and that even when the patient's feeling of pain seems to be benumbed rather than exalted. Very little irritation or pain, or exposure to cold, superadded to this state, I believe to be sources of great additional danger, both immediate and secondary; and to these causes I attribute much of the fatality which attends primary amputation in civil hospital practice, where most of the cases are brought from some distance—often from a long distance—by cart or railway. The state of a patient with a torn and broken limb, carried even with the greatest care, is aggravated by the slightest movement, and fresh shock superadded. I have on two occasions accompanied patients under these circumstances from short distances in the country, and though an opiate had been given, and the fractures were arranged and supported, the limbs slung, the carriages very easy and the roads good, yet the slightest jolt or sudden motion of the horses caused exacerbations of suffering and faintness, requiring the administration of stimulants. In one of the two cases alluded to the soft parts were principally injured, the fibula alone being fractured. If such were the effects of removal under every advantage, I could not help asking myself what must be the condition of most patients brought to hospital with severe injuries? The loss of blood resulting from the injury, and any subsequent hæmorrhage, either during the transport of the patient or in the amputation, is so evident a cause of danger, so frequently associated with and aggravating the shock, that I need not dwell on it further than to point out the necessity of prompt attention to this so soon as the patient comes under your care. You should not only be satisfied that there is no hæmorrhage externally, for I have frequently found bleeding taking place into and infiltrating the limb; and the patient may sink from this cause. Indeed, I have not unfrequently been obliged to amputate when the pulse was very weak, because, from this kind of hæmorrhage, it was obvious that delay would only have led to greater debility from loss of blood. Under other circumstances, it is always proper to have a fair amount of reaction before

operating. Having said this much of the effects of shock and loss of blood, let us look now how some primary amputation cases are situated as to these dangers.

Of the five cases of primary amputation at the hip-joint, one was brought a distance of more than fifty miles, partly by cart, over bad roads in a hill district, and partly by railway, and was admitted into hospital late in the evening, the injury having been received about half-past six in the morning. The injury occurred from the explosion of a large iron flask containing gunpowder, which he had in the pocket of his trousers. The whole of the thigh, abdomen, and lower part of his thorax were scorched ; all the soft parts on the front and inner part of the thigh, with the exception of the femoral artery, torn through ; and the branches of the profunda were bleeding into the textures of the limb, so that amputation had to be performed at once. In another of the fatal cases the patient had one limb shattered and torn off immediately below the knee, and a severe compound fracture of the other leg. In this case there had been great loss of blood at first from the torn arteries of the severed limb, but it had been arrested by tying a handkerchief round the limb and twisting it tight by means of a stick used as a rack-pin. In the third case, the patient was brought from a distance, and had evidently suffered both from severe shock and loss of blood prior to the operation. Neither of the last two cases ever fairly recovered from the effects of shock. In both of them the injury was caused by a train of railway trucks passing over the limbs, and the patients were otherwise bruised, though there were no internal injuries. In another case, a little girl, six years of age, was run over by a heavily-laden cart. The wheel passed over her right knee and left thigh, producing a lacerated wound of the former and a compound comminuted fracture of the latter, with extensive destruction of the soft texture in front to within three inches of Poupart's ligament. The accident happened in town, and the child was admitted into hospital half-an-hour after the accident. There had been profuse bleeding at first, but that had been

arrested before admission. I amputated some hours afterwards, when reaction was established. There was little sound texture to form flaps, and some sloughing of the margins of the flaps took place. For a time, however, the wound looked so healthy that I was in hopes of her recovery. But ultimately she became very much exhausted, and died about eighteen days after the operation. In this case there were some peculiar conditions which probably affected the result unfavourably. Besides the injury of the limb amputated, there was a laceration of the textures over the right knee, a second source of irritation. But there was also an unfavourable state of constitution, for the injured knee had been the seat of disease, and she had previously suffered from necrosis. Both these conditions had been successfully treated in my wards about a year previously ; but, of course, the state of the parts when subjected to a new irritation must have reacted unfavourably on the health, tending to produce exhaustion after the amputation.

The fifth, which is the first and only successful case of primary amputation at the hip-joint, so far as I know, which has yet occurred in Scotland, was performed under different circumstances. I was sent for and performed the operation in the country, so that the lad had only been removed from the railway station, where the accident happened, to his own home, a very short distance. He was carefully carried on a litter, the injured limb having been first supported by a splint. In all other respects, the conditions were certainly not more favourable than in hospital. The injury was a severe one, attended by some loss of blood, though that was arrested by the medical man who first saw him. Eight or nine hours had elapsed from the time of the injury till I reached him, and he was then much depressed. The operation was performed under certainly less advantageous circumstances than in hospital. For although the professional assistance I had was excellent, still I had to depend upon non-professional aid for the performance of some important duties ; and when I add that the operation was performed in a small room, with no other light but that afforded by

two small tallow candles and a wax taper which I had brought with me, the circumstances will not compare favourably with the advantages of an hospital operation. Yet the compression of the vessels was so efficient, that the amount of blood lost, when collected and measured, did not quite half fill a small teacup. In regard to the after-treatment, the patient was no doubt in the country, and it may be said that pure air is everything, and certainly it is most important ; but the house was small, the room in which he lay, so small that one person only could stand between his bed and the wall, and the only window in it was composed of a single small pane of glass. The street of the village was narrow, and with surface drainage. Yet this patient made a good recovery. Was it due to the pure country air, or to his not having been removed to a long distance after the injury, and so having been saved from increased shock ? I cannot help thinking that it was chiefly due to the latter circumstance. I have come to that conclusion from what I have observed in cases of other primary amputations, such as those through the thigh and leg ; for, whilst the amputation of the hip is undoubtedly a very serious operation, similar circumstances to those I have mentioned seem to determine the favourable or unfavourable result in other amputations. In the fatal cases of primary amputation of the thigh and leg, almost all had been brought from a distance, or after long exposure and having lost blood, and in the majority other injuries were present. In the successful cases, on the other hand, the operation was either performed in the country, where the accident took place, or else the nature of the injuries was peculiar, consisting either of laceration and destruction of the soft textures, of ploughing up of the texture of the bone by toothed machinery, or compound impacted fracture, or else means had been taken to arrest all bleeding and adjust the limb previous to their removal to the hospital. The patients in the successful cases had thus either been saved all shock, except that of the original injury, or any secondary shock in those who were removed to hospital had been considerably diminished either by the character of the lesion or the means taken to prevent motion of the

injured parts and loss of blood. I think that the circumstances alluded to are obviously in accordance with what we might expect when we consider the effects of such injuries as those entailing a necessity for amputation. By the first shock of the injury the patient is as it were stunned, the sensorial functions are disturbed, and his general feelings benumbed, so that pain is seldom complained of; but as he revives and becomes excited, his nervous sensibility becomes exalted, disturbance in this condition causes excessive pain, gives rise to shivering and a feeling of sinking, and produces a marked effect on the pulse. This I have observed in the cases in which I accompanied the patients to town, and I therefore have come to regard removal of cases requiring amputation as of very doubtful propriety. But whilst I draw your special attention to this, there are various other conditions which are obviously causes of danger in cases which are brought even from a short distance. The patients may be exhausted by exposure, loss of blood, and prolonged suffering, as happened in some instances where the accident occurred during the night, and the sufferers remained undiscovered for many hours during an inclement wintry night.

Gangrene of the stump is not, according to my experience, frequent in cases of primary amputation. I have met with only three cases in my own practice. Two of these occurred after amputation at the upper third of the thigh, for severe railway injury, and in both there had been great loss of blood previous to the patient having been brought into the hospital. In one the gangrene attacked the surface of the stump on the second day after the operation, and proved rapidly fatal. In the other patient the gangrene was partial, arising apparently in some deep muscles which had suffered injury above the point of amputation. A considerable part of the wound had healed on one side of the stump when foetid discharge began to take place. Arterial hæmorrhage occurred, and on opening up the stump to arrest the bleeding, the sloughy state of the deep part of the wound was noticed: the sloughing had opened into the femoral artery about an inch and a half above the point where it had been tied in

the amputation. The vessel was secured higher up, but the deep-seated sloughing continued and the patient gradually sank. In the former of these cases, the patient had suffered both from excessive shock and great loss of blood; and when brought into hospital he was so collapsed that it was doubtful whether he could bear the operation, but as bleeding was going on into the tissues, the operation seemed his only chance. The main artery was compressed and stimulants given, but during his removal from the receiving-room to the operating theatre his respiration and pulse became so feeble, that I had again to give stimulants and wait for some reaction before operating. We can be at no loss to understand how, in a patient so debilitated, the general and local vital powers should be so impaired as to lead to gangrene, instead of healthy reparative action. The second case was more insidious in its course, as beyond the fœtid discharge from one part of the stump, there were neither local nor general symptoms indicative of gangrene. The secondary hæmorrhage caused by the sloughing, by debilitating the patient, doubtless made the after-progress of the gangrene more rapid. The third case of gangrene of the stump occurred after an amputation of the forearm, performed on account of gunshot wound of the hand. The patient, a man of excessively intemperate habits, was attacked with delirium tremens the day after the operation. Erysipelas of the stump, forearm, and arm supervened, and assumed the gangrenous character and proved fatal. In this case the previous habits and broken-down constitution of the patient, rather than the amputation or the nature of the injury, must be looked to as explaining the tendency to gangrene.

The most general cause of death in cases of primary amputation, when the patients survive the more immediate dangers of shock and loss of blood, is the condition termed pyæmia.

Pyæmia is often spoken of as if it were specially an hospital disease, depending on the effects of hospital air. From the greater number and severity of the surgical cases occurring in hospital, we can scarcely wonder that pyæmia should be more

frequently met with there than in private practice ; but it is by no means confined to hospitals ; and from considerable experience and observation of this diseased state, I believe that its occurrence is much more determined by the state of the patient prior to an operation, or to depressing causes occurring afterwards, than is generally admitted ; and that in cases of primary amputation, besides the more obvious depressing causes, certain forms of lesion specially conduce to its occurrence. Thus I have noticed that the risk of pyæmia is always greatest in cases where the amputation has been performed through the continuity of the bone or bones which had been fractured. This is specially noticeable in primary amputation of the leg and upper arm, for railway and gunshot injuries. In these cases the fatality attending the operation is very great, whilst in cases where, from the severity and extent of the injury, we are forced to amputate beyond the injured bone at the shoulder-joint, or immediately above the knee, the success is greater. In cases of amputation at the shoulder, I am so satisfied of the diminished risk to the patient, that I feel relieved when the nature of the injury leaves no room for amputation through the injured humerus. In the fatal cases of primary amputation at the shoulder, the deaths were due to the effects of other injuries, and the great loss of blood in one case prior to the operation ; but in my own practice I never saw a patient die from pyæmia after primary amputation at the shoulder.

As a general rule, the less of the limb removed, the less is the risk, but there are exceptions to all rules ; and in cases where a bone is much shattered, the risks of acute necrosis and osteo-myelitis attacking the bone of the stump, and so inducing pyæmia, are so great as to warrant in many cases amputation at or above the neighbouring joint. The co-existence of other injuries not in themselves dangerous, such as simple fracture, or even contusions of other parts of the body, always exercise an unfavourable influence in cases of primary amputation ; and, of course, when these injuries are more severe, the risk is greatly increased. In most cases of pyæmia the bone of

the stump is found necrosed, and the medulla is often seen to project like a fungoid mass. In such cases it is usually assumed that this condition is the cause of the blood-poisoning. No doubt, it may be said that it is quite as likely that the state of the bone is the effect rather than the cause, for all the soft parts show diseased action as well as the bone, and besides we occasionally see even acute necrosis of the bone of a stump without pyæmia supervening. Still the possibility of the disease of the bone being the cause, is just another reason for amputating beyond the continuity of a bone which has been severely comminuted and fissured longitudinally.

The moral causes which may influence the result unfavourably are more difficult to trace than even the physical. In all cases of severe injury, however, and especially in cases involving mutilation, the mental state, leading to depression, cannot be overlooked. The moral influences of the different circumstances in which, in such cases, the civilian and the soldier are respectively placed, have been stated as amongst the causes predisposing to the less favourable results of primary amputation in civil as compared with military practice.

“A tradesman,” says the late Sir G. Ballingall, “who has, perhaps, an indifferent constitution, and a wife and family dependent upon his exertions, is admitted with an injury requiring amputation, which may be the result of an accident originating in intoxication, ignorance, or folly, and by which he finds himself suddenly reduced to misery and dependence ; while the soldier, again, with a constitution originally sound, and accustomed to contemplate such an accident, loses his limb in a good cause, under circumstances creditable to himself and duly appreciated by his country, from which he is certain of a pension for life.”

Now, these appear very satisfactory and obvious reasons why mental depression and anxiety might be expected to be more frequent in the one case than in the other. But, whilst I consider these moral states as most important, I believe it will be found difficult to estimate correctly their influence, except in

regard to individuals. For so much depends upon the natural mental constitution, the education, habits, and age of each, that when we come to examine the question closely, it will be found almost impossible to draw any general deductions in regard to it.

The class most liable to such injuries is not in general remarkable for habits of thoughtful calculation with regard to future possibilities, consequently such opinions as that I have quoted, refer rather to what we might expect to be the state of feeling, than what we actually often find it to be. Were patients generally much influenced by the consideration of all the evils which the loss of a limb might entail upon their future prospects, we might expect to see this feeling and its unfavourable effects most generally in amputations of the upper extremity, for surely no other mutilation involves so much prospect of misery to a labouring man or mechanic. Again, when we find a man, as I have seen, suffering from the loss of a limb, his wife struck down with fever, both lying helpless in a miserable room, themselves and their children dependent on the care of strangers, we would expect this depressing influence to exert its utmost power. Yet the man in that condition seemed but little affected, and his case went on favourably to a perfect cure.

In two cases in which the bad effects of mental depression were most obvious, the circumstances were peculiar. In one, the man had in former years suffered the loss of an arm, and had felt painfully all the difficulties and privations which that loss entailed, and, when advanced in life, he lost the leg of the same side. Thus, he could not but feel to what a perfectly helpless condition such an unusual form of mutilation must reduce him, by depriving him of any means of supporting himself and his family. In the other case, the patient's feelings were painfully excited by the conduct of a young woman, to whom he was on the eve of being married, and who, immediately on hearing that he had suffered amputation, showed the depth of her affection by removing the portion of the furniture she had provided for their intended home. Previously to hearing this, he had been in good

spirits, and—except that the pulse kept somewhat high—appeared to be going on favourably; this, intelligence, however, completely depressed him, and seemed to predispose to the unfavourable result.

In such cases as these last, mental depression and despondency can hardly be overlooked as having an important influence on the results. Still, I repeat, we can draw no exact general deductions where so much depends on the mental constitution and temperament of the individual.

There is, however, one mental state which should always be recognised, and which should influence our practice, not only in cases of amputation, but in all operations—I mean the effect produced upon a patient by witnessing or hearing of the death, or of any unfavourable condition happening to another who has undergone a similar operation. This is of course most likely to occur in hospital; and in my own practice I make it a rule to avoid placing two patients, about to undergo the same operation, in one ward, more especially if the prognosis in either case be unfavourable; and I feel satisfied from observation, that what are termed in some hospitals “Operation Wards,” are very objectionable both on this and other grounds, and that operation patients get on better when scattered throughout the different wards, amongst the less serious cases.

In regard to the question of secondary amputations, for traumatic gangrene and those for burns, I have already discussed these subjects, under their appropriate heads, in the earlier part of the Lectures, and therefore need not speak of them here.

I now turn to the results of the amputations performed for disease, with the view of considering what they suggest. I have already said that an operation in itself may be comparatively free from danger, and yet the condition of the patient, or the circumstances under which it is performed, may lead to its performance being attended with great mortality. Perhaps no better example of this could be found than in comparing the results of amputation of the leg for disease with those for injury. Out of 22 cases of amputation of the leg for disease 21 recovered and 1 died; whilst out of 31 performed for injury, either primarily or

secondarily, only 16 recovered, and 15 died. But to pass from this, let us now examine into the results of amputations performed for different forms of disease.

One of the most frequent amputations is that at the lower part of the thigh for disease of the knee-joint. The absolute results of my practice in this operation give 79 cases, of which 67 recovered and 12 died, or an average of 1 death in $6\frac{1}{2}$ cases—not a very large mortality for an operation of such magnitude, and so frequently performed as a last resort. There is, however, one thing which I regret I have not sufficiently attended to in connection with this class of cases—namely, to distinguish the cases of gelatinous degeneration from those of articular caries and ulceration of the cartilage. I have a very strong impression that the result of operations, whether excisions or amputations, for gelatinous degeneration will be found much less successful than in other forms of articular disease; and of late, since I have been careful in noting the distinction, my statistics seem to justify the impression. Thus, out of 10 cases of amputation of the thigh for disease of the knee performed by me between February 1867 and 1st May 1869, 5 were cases of articular caries and ulceration of the cartilage, and 5 were cases of gelatinous or pulpy degeneration. Of the former all recovered; of the latter 2 died. I have already pointed out, in speaking of articular disease and of excision of joints, the constitutional complications to which I attribute the fatal results in the gelatinous form of disease.

When we compare the results of amputations for disease of the knee with the results of those performed in cases where the affection of the joint had either supervened upon necrosis of the femur, or in which the patient had previously suffered from necrosis, and where the sequestrum had been removed and a cure obtained, and the joint affection subsequently appeared, the difference in the mortality is very startling. Of 13 cases of the class referred to, only 8 recovered and 5 died. It seems to me that this mortality is not merely accidental in a limited number of cases, but may be traced to certain constitutional conditions. You may recollect

that amongst the fatal cases of excision of the knee-joint 2 were of this kind, and I believe that the unfavourable result in such cases is due to the unhealthy state of constitution in which idiopathic necrosis occurs, aggravated by the debilitating influences present during the prolonged process of the disease, the repeated formation of deep-seated abscesses, and the discharge prior to, and even after, the sequestra have been thrown off or removed. In such circumstances, when disease of the joint supervenes either immediately in connection with the necrosis, or manifests itself as distinct disease some time after the necrosis has been cured, it seems to me, we have to deal with a state of constitution very specially predisposed to pyæmia or other form of blood-poisoning. In the rarer cases, where amputation had to be performed for chronic necrosis of the shaft of the femur, the same conditions seem to have led to similar results. Of 6 such amputations, 4 recovered and 2 died.

As regards amputation in acute necrosis of the femur and humerus, whether the diseased action arise idiopathically or from injury, the results are so disastrous that for many years I have refrained from operating, as I believe the patient has a better chance for life by trusting to nature and careful treatment than by having the diseased limb removed. I know that it is very trying to witness the sufferings of young patients when labouring under the irritative fever accompanying acute necrosis, when it seems as if it were impossible for the constitution to bear up against the exhausting process, and when removal of the affected mass by amputation seems so ready and simple a resource. Doubtless the condition of the patient is very dangerous ; but I repeat, from experience and observation of a large number of such cases, that the patient has a better chance without the operation ; for we must remember what we are very apt to forget, when looking only at one view of the case, the unfavourable conditions which are likely to supervene after an operation performed in such a state, and when there is such a risk of blood-poisoning. After a time, when the irritative fever has passed into hectic, and the discharges become more dis-

tinctly purulent, and when neighbouring joints are affected, amputation may be resorted to with better prospect of success ; but in most cases the surgeon will find himself rewarded for his anxiety and forbearance by seeing his patient recover without mutilation.

The amputations performed for malignant tumours are amongst those that swell the mortality. But it may be noticed that the favourable or unfavourable results seem to be dependent on certain conditions as to the situation of the tumour, whether it is developed in the bone and confined to that structure, or has commenced in or involved the soft parts of the limb, and also by the situation at which amputation is performed. Although, in all cases of malignant disease, the state of the blood and peculiar cachexy which accompany such disease, have a marked influence in predisposing to pyæmia, thereby affecting the immediate result as to recovery from the operation ; the risks seem most marked in cases where the tumour has originally been developed in the soft parts, or in those where the soft parts have become involved secondarily. Of 11 amputations through the femur for malignant tumour, only 5 recovered. All of the successful cases were for tumours of the bone, and in 4 of them the growths were confined to the condyloid portion of the femur, whilst the amputation was performed at the junction of the middle and upper third of that bone. In the fifth case the tumour involved the lower part of the femur above the condyle, and the operation was performed through the trochanters. In 2 of the 6 fatal cases the condyles were originally affected, but in one of them the patient had refused to submit to the operation till the tumour had involved the shaft and soft parts. The other 4 were tumours of the shaft at its lower part. In these cases, except one where the tumour seemed limited to the condyle, amputation through the trochanters was performed. In 2 cases death resulted from a form of secondary hæmorrhage, or rather a continuous oozing of a sanguineous discharge from the general surface of the stump ; the others died with symptoms of pyæmia. Now, if we contrast these results

with those of cases of a similar character where the amputation was performed beyond the bone affected, I think it will appear that not only do we give the patient a better chance of subsequent immunity from return of the disease, but that we diminish the immediate risk to life by performing what at first sight may appear a more serious operation : Thus—of 4 cases of amputation at the shoulder-joint for malignant tumour of the arm, 3 recovered and 1 died ; of 3 amputations at the lower third of the thigh for malignant tumour of the tibia, all recovered ; and of 3 cases of amputation at the hip-joint, 2 recovered and 1 died. The fatal case of amputation at the shoulder was that of a boy whose friends had declined to permit amputation two years previously, and who as strenuously urged its performance when the tumour had involved the soft parts, and when repeated hæmorrhage had so exhausted him that I performed the operation only under protest. In regard to the hip-joint, the two successful cases were examples of malignant tumour developed in the femur, and they both made excellent recoveries, although they were much exhausted at the time of the operation. The unsuccessful case was one of cancerous tumour of the soft parts. The patient had declined interference eighteen months previously, and the tumour had increased greatly, with marked cachexy, at the time of the operation.

If, therefore, we exclude these two cases, and confine our observation to malignant tumours limited to the bone, all the cases of that kind in which amputation was performed beyond the affected bone recovered, whilst in those where amputation was performed through the continuity of the affected bone, 6 out of 11 died. Amputation at the hip I believe is really attended with as little if not less risk in its performance than even amputation through the trochanters ; and, whilst it affords the best chance for complete removal of the disease, it is also attended in most cases with a better chance of recovery from the operation. At the same time, when the tumour is limited to the condyle of the femur, I think that in the early stage amputation above the middle of the thigh is sufficiently safe, as in none of the four

successful cases alluded to has the disease returned, though several years have passed since the operations were performed.

Amongst the miscellaneous cases of amputation, whilst some of them possess features of individual interest, they suggest but little in regard to general principles. I would merely notice the case of amputation for gangrene arising from diffuse popliteal aneurism, as one of those which, I think, unfairly swell the mortality of amputation statistics. So far as regarded the amputation, no case could have progressed more favourably, the stump had nearly healed, and the patient was sitting up in bed when he died in an instant from rupture of an aneurism of the aorta into the pericardium, a condition totally unconnected with the amputation.

These general remarks on amputation have extended to greater length than I intended ; but before concluding, I would, to prevent misapprehension, recapitulate, in the two following statements, some points which I wish you to keep in mind :—

1st. In all ordinary cases the general rule holds good, that the smaller the amount of the body removed, the less will be the risk to life. But, in cases of primary amputation, where the bones are much comminuted or longitudinally fissured, I believe that amputation beyond the injured bone really diminishes the risk of pyæmia ; and that in cases of malignant tumours of the shaft of a bone, amputation beyond the diseased bone is distinctly indicated, as it not only affords the greatest chance of immunity from the disease recurring, but actually diminishes the immediate risks.

2d. That whilst, as a general method, I prefer a long and short flap, with a moderate amount of muscle, to form a covering for the bone, the muscular substance saved should never be great, as that adds to the risks of suppuration and pyæmia ; and the muscle should merely be preserved at that part of the flap corresponding to the end of the bone. But in all cases of amputation for injury or malignant disease, I consider that two equal

flaps of smaller dimensions, or the modified circular method, are attended with less risk of retaining diseased structure, or of being followed by sloughing or pyæmia, and that in such cases little or no muscular structure should be retained. The form of the stump must yield to the more important considerations of the complete removal of disease, and diminution of the risk to life.

LECTURE LXXXVII.

Special Amputations—The Upper Extremity—Amputation of the Distal Phalanx of Finger : of the whole Finger ; of Fingers and their Metacarpal Bones ; of the Thumb—Partial Amputation of the Hand—Amputation at the Wrist-Joint—Lines of Incision and form of Flaps—Amputation of the Forearm—By Double Flap—Teale's Method by transfixion.

THE general subject of amputation has now been fully discussed. It therefore only remains for me to consider, as briefly as possible, the SPECIAL AMPUTATIONS. I shall begin with those of the upper extremity.

AMPUTATION OF THE DISTAL PHALANX OF A FINGER is an operation which is seldom performed on the living body. In cases where the part is diseased, we generally wait until the bone has become loosened by exfoliation, and then separate it through a free longitudinal incision made in front of or at the side of the finger. By these means the digital extremity is saved, and a more satisfactory result obtained than could be by amputation. When the same part of the finger is injured by an accident to such an extent as to warrant its removal, the soft textures are generally so much destroyed as not to leave sufficient material for the formation of a flap to cover the end of the bone. The operation is one, however, which the student may practise, with advantage to himself, on the dead subject, as giving him neatness and dexterity in performing disarticulation.

In amputating the distal phalanx of the finger, we must keep in mind that the proximal end of the phalanx has a slight projection, which overlaps the articular end of the middle phalanx, when the finger is kept straight ; but when the distal

phalanx is flexed the relations of the bones are altered, and the articular end of the middle phalanx is then made prominent, and the ligamentous and other soft textures covering it, are rendered tense. In performing the operation, the surgeon grasps the extremity of the phalanx between his finger and thumb, flexes it as far as possible, and, with a narrow bistoury, cuts directly upon the projecting end of the middle phalanx, carrying his incision fairly across the posterior aspect of the joint, which is thus opened. He next, with the point of the knife, divides the lateral ligaments, so as to free the articular end of the distal phalanx and allow the blade of the knife to be passed in front of it. He then cuts a flap sufficient to cover the stump from the anterior aspect of the finger. Or the proceeding may be reversed when the joint cannot be bent. The surgeon then transfixes the soft parts in front of the joint, and cuts the flap; next opens the articulation from before, divides the short lateral ligaments, and disarticulates the phalanx by cutting backwards. When, owing to disease or injury, soft parts cannot be obtained to cover the end of the middle phalanx, we require to remove a portion of it, and with this view we must shape our flaps from the sound textures, and with the bone-pliers snip off a portion of the bone. If we are thus able to leave the attachment of the superficial flexor tendon, the stump so left will be useful; but when we have to amputate close to, or at, the articulation between the middle and proximal phalanges, it is better to amputate at the metacarpophalangeal articulation, as the short stiff stump left in the former case would be a deformity, and rather interfere with the use of the other fingers. The only case where it is sometimes advisable to amputate at the junction of the middle and proximal phalanges, is in the case of the forefinger, as the stump serves as a counterpoint to the thumb for prehensile purposes.

AMPUTATION OF THE FINGER at the metacarpophalangeal joint is performed thus:—An assistant holds the forearm and wrist firmly with one hand, whilst with the other he separates the fingers on either side of the one to be removed, and bends them

Fig. 1

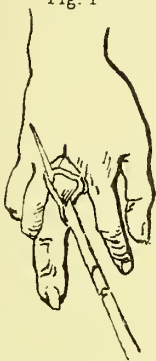


Fig. 2

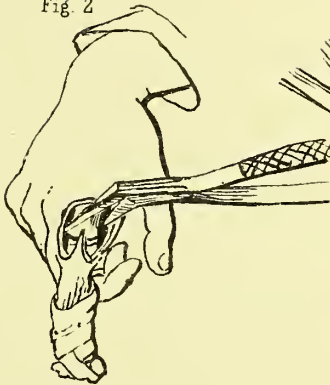


Fig. 3

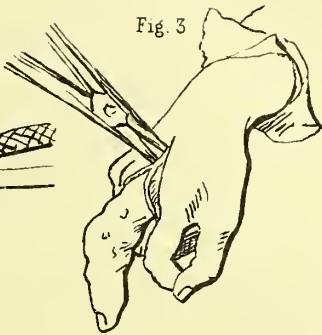


Fig. 4

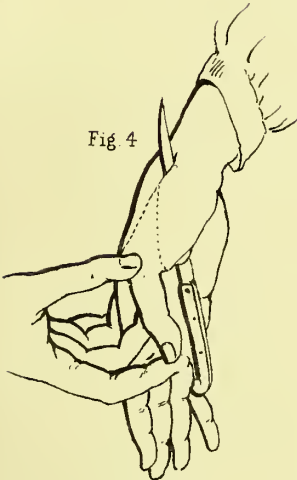


Fig. 5

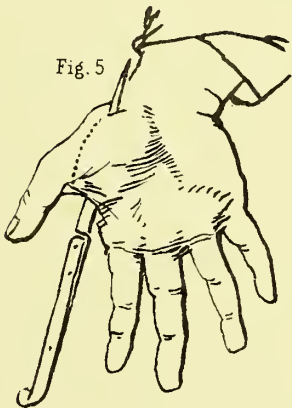


Fig. 6



Fig. 7

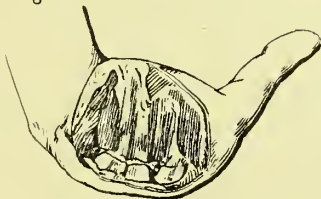
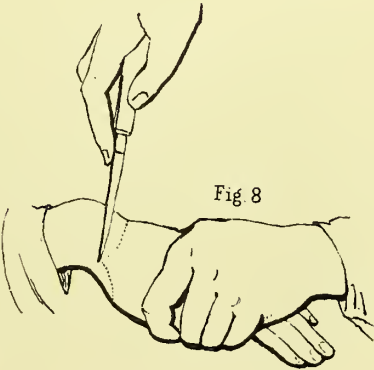


Fig. 8



so as to keep them out of the way. The surgeon, standing in front of the patient, seizes the doomed finger with his left hand, and uses it as a lever, to twist it in different directions to render the ligamentous textures tense over the articular end of the phalanx, so as to effect their division more readily. The point of the knife is then placed over the middle line of the metacarpal bone, at least half-an-inch higher up than the joint. The incision is carried straight down, till near the web between the fingers, when it is made to diverge slightly to one side of the finger, and carried fairly down into the palm, in an oblique direction, converging again towards the middle line; from this point it again diverges towards the web, on the opposite side of the finger, and is then made to pass upwards, converging to and terminating in the original incision on the dorsal aspect of the hand. The extensor tendon, capsular and lateral ligaments, are then divided, and disarticulation having been thus effected, the surgeon draws down and extends the finger, and removes it by dividing the flexor tendons at one sweep of his knife. The result is a V-shaped incision, which, when the fingers are approximated, forms a single linear cicatrix. The digital arteries require to be secured, and a point or two of suture introduced, to close the wound. When the oval method is adopted, the incision is brought round the root of the finger without cutting into the palm; but this results in a puckered projection—an unseemly appearance, which is avoided by the V-shaped incision. The operation may also be performed with the same result by the method represented in Plate xxxv. Fig. 1. The hand being held as before, with the fingers well separated, the surgeon lays the edge of a long narrow bistoury against the tense web close to the finger, and cuts into the joint, and by a rapid movement causes the heel of the knife to cut the palm, and the point of the knife to divide the skin on the dorsal aspect higher up beyond the joint, twists the finger so as to divide the lateral ligaments, pushes the articular end of the phalanx aside, to allow the knife to pass round it, and completes the operation by cutting through the web of the fingers

on the opposite side to where he began his incision. This latter method, though simple and rapidly effected, requires practice, to avoid cross-cutting in rounding the end of the bone to cut outwards. By whatever method the finger has been amputated, care should be taken to preserve the parallelism of the contiguous fingers ; and for this purpose I always introduce an elongated pad of lint between the fingers, extending from the points to the articulation of the middle with the proximal phalanx. This prevents their being dragged too closely together, and so impairing the usefulness of the hand. The less dressing over the incision, the better.

The mere cartilaginous head of the metacarpal bone may be removed without injury, as some think this facilitates the healing of the wound, although, for my own part, I think it better to leave it on. But unless disease or injury compel us, on no account should the broad portion of the metacarpal bone beyond the head be removed in the case of the middle or ring fingers. It is sometimes advised as leaving a neater hand ; but it is quite inadmissible on such a plea. That portion of the bone forms the keystone of the metacarpal arch, and its removal permits the other metacarpal bones to fall inwards, and so the usefulness of the hand is impaired. In the case of the little or forefinger, which are placed laterally, the objection does not exist, and the oblique section of their metacarpal bones beyond the articulation obviates deformity. In the case of the forefinger, the usefulness of the hand is increased rather than impaired by the procedure, as then the middle-finger takes the place of the forefinger in relation to the thumb, more easily than when the projection of the metacarpal bone is present. The method of removing the end of the metacarpal bone of the forefinger is shown in Plate xxxv. Fig. 2. The incision of the soft parts is similar to that already described, only placed to the side, so that the cicatrix may be less observable. The section of the bone is best effected by the oblique cutting bone-pliers.

In amputation of a finger, along with a portion of its metacarpal bone, the incision is commenced half-an-inch above the

point at which we contemplate dividing the bone, and is carried down along the middle line of bone till it reaches the web of the finger, where it diverges to form the V-incision, as in amputation at the metacarpo-phalangeal joint. The extensor tendon is cut across, and the metacarpal bone cleared from the soft parts attached to its sides. Its section is then accomplished by Liston's bone-pliers. They should be applied perpendicularly, with their smooth surface towards the part to be left. When the bone is divided, the end is raised by means of a hook or forceps, and with the point of the bistoury cutting upon the bone, we clear its palmar surface with the least possible interference with the structures in that region, dividing the flexor tendons as we cut out at the web between the fingers. Thus the palm is scarcely touched, and a comparatively superficial wound results. Formerly, when the metacarpal saw was used, the whole thickness of the palm was necessarily divided to permit of section of the bone. When the little finger is the subject of this operation, the incision is made on the ulnar side of the hand to avoid deformity, not on the back. Disarticulation of the fingers at the carpo-metacarpal joint should never be performed if we can leave even the small portion of the metacarpal bone, because, by opening any one of the articulations here, there is communication with the whole range, and inflammation of these irregular articulations is very apt to occur, and serious consequences, both local and general, may follow. In some cases, as for malignant tumours of a metacarpal bone, we may be obliged to disarticulate. In removal of the little finger, with its metacarpal bone, the incision of the soft parts is made along the ulnar aspect of the bone; and in disarticulating, the knife passed between it and the fourth metacarpal bone, should have its edge turned towards, and be made to cut upon that metacarpal bone, as the articulation is oblique, and division of the strong interosseous ligament is most readily effected in this way, and disarticulation is then easily accomplished.

AMPUTATION OF THE THUMB.—Amputation of the distal

phalanx, or at the joint between the proximal phalanx and the metacarpal bone of the thumb, is performed in the same way as in the fingers ; but the usefulness of even a small portion of the thumb is so great that it is important to save parts of the phalanges by irregular operations which we would not think of performing on the fingers. Amputation of the thumb, along with its metacarpal bone, is therefore avoided except in cases of dire necessity. When, however, disarticulation is required, it is not obnoxious to the risks incurred in amputating the other metacarpal bones at their junction with the carpus, for the os trapezium, with which it is articulated, lies on a plane anterior to, and does not implicate the other carpal joints.

The amputation may be performed in various ways. The best plan is by the V-shaped incision, either made by cutting from the skin, as in the case of the fingers, or partly by transfixion, and partly by incision from without (Plate xxxv. Figs. 4, 5, and 6). The latter method is more rapid and elegant in execution, and gives the same result. Suppose the left thumb is to be removed. The surgeon grasps its extremity with the forefinger and thumb of his left hand, inserts the point of a long bistoury on the dorsal aspect of, and about half-an-inch above, the carpo-metacarpal joint, and carries the blade obliquely over and towards the ulnar side of the metacarpal bone, with a bold and decided sweep, so as at once to divide the parts forming the web between the thumb and index finger. Next, without withdrawing the point of the bistoury, he bends forward the thumb, as represented in Fig. 4, Plate xxxv., so as to relax the muscles forming the ball of the thumb, passes his knife in front of the metacarpal bone, brings its point out at the first incision, and turns its edge almost directly towards the skin ; pushes the thumb outwards, as in Fig. 5, to render the parts tense, and cuts toward the surface ; then, forcibly throwing back the thumb, he opens the joint between the trapezium and metacarpal bone of the thumb, and completes the disarticulation. If the right thumb is to be amputated, the surgeon begins by transfixion, and completes his palmar flap or incision ; and then, applying the heel of

the knife to the web of the thumb, carries the blade rapidly through the soft parts on the dorsal aspect, terminating in the first incision at the upper point of transfixion, and concludes by disarticulating, as in the former case. By this method the amputation can be performed with great rapidity, and without withdrawing the knife from the incisions till they are completed. The appearance of the elliptical wound left after disarticulation is shown in Fig. 6, Plate xxxv., and the result after the wound has healed is a simple linear cicatrix.

PARTIAL AMPUTATION OF THE HAND is generally required for injury, and consequently the operative procedure must vary in each case, according to the amount and direction of the destruction of parts. Under certain circumstances it may be performed by means of a large flap from the palmar aspect ; the metacarpal bones being removed, or sawn through close to the carpal articulation, and the thumb preserved, as represented in Plate xxxv. Fig. 7, or by two smaller flaps anterior and posterior. In many cases we must construct the best covering we can by shaping the sound portions of the soft textures, to adapt themselves to the surface of the stump. In all cases where we can save a finger, or a portion of a finger, as an opponent to the thumb, it is most important to do so ; but even when the thumb and a portion of the hand can be saved, it should be done, as an artificial opposing power can be fitted to the stump. If, however, the carpo-metacarpal joints of the fingers, and that of the thumb, be injured, and its long flexor tendon torn, there is little use, and considerable risk, in attempting partial amputation, as the movement of the parts would be lost, and unhealthy inflammation and suppuration very likely to occur. Amputation at the wrist, under such circumstances, would be the better plan. Whenever we can avoid opening into the carpo-metacarpal articulation, we ought to do so, for reasons already given.

AMPUTATION AT THE WRIST affords excellent results in suitable cases, but these are not of common occurrence. The object

in performing this operation, instead of amputating higher up, is not to get a longer stump, but with the view of retaining the movements of pronation and supination, and consequently the greater use of the stump. To obtain this advantage, the lower radio-ulnar articulation must be sound. Hence there is no use in performing this amputation in cases of disease of the wrist-joint, as in such cases, where amputation is warranted, the lower radio-ulnar articulation is almost always implicated, and we obtain a better stump by amputation of the forearm. The cases suitable for amputation at the wrist are those of injuries in which no part of the hand can be saved, but where the lower radio-ulnar articulation is intact, and where we can obtain sufficient flaps of sound skin to form a covering for the stump. I have performed the operation with very successful results in several such cases. The modified circular method is in my opinion preferable to a flap saved from the palmar aspect, as sometimes recommended. In performing the operation, the assistant who holds the forearm should draw up the integuments tightly. The surgeon then makes a slightly curved incision, with its convexity downwards, on the dorsum of the wrist. This incision should begin about an inch below the styloid processes of the ulna and radius, and should join, with a gentle curve, a similar incision carried over the forepart of the wrist. These incisions should divide the skin, fat, and fascia ; and a few touches with the knife enable the assistant to retract the loosened integuments to a level with, or a little above, the styloid processes. The flexor and extensor tendons are rendered tense, and divided with a circular sweep of the knife below that point. The joint is then opened by dividing the lateral ligament on the outer or inner side, as most convenient for the operator, and disarticulation accomplished from behind forwards. By following this plan, we find that when the operation is completed the flaps come well over the ends of the bones, which are covered with sound skin ; whereas, in the ordinary flap method, the styloid processes correspond to and tend to project at the angles of the incisions where the bases of the flaps unite. The vessels requiring ligature, in this opera-

tion, are the radial and ulnar ; sometimes, but rarely, the terminal twigs of the interosseous artery. During the after-treatment, the forearm should be placed in the position between pronation and supination.

AMPUTATION THROUGH THE FOREARM may be performed by the double-flap method, by transfixion, by cutting the flaps from without inwards, so as to avoid redundancy of muscle, or by a long and short flap on Teale's principle. By any of these methods an excellent stump can be obtained, and our choice is often regulated by the conditions demanding the operation. In all cases of primary amputations, the plan of cutting our flaps from without inwards answers best ; it enables us to shape the flaps more regularly, to avoid injured tissue, and to leave only a very moderate amount of muscular and tendinous structure in the flaps. If we operate by transfixion in such a case, the tendons and muscles loosened from their connections by the injury yield, and are dragged out before the knife and cut irregularly, leaving a redundancy of muscle and ragged surface. In operating, we shape two equal rounded flaps from the anterior and posterior aspects of the forearm, dissect the integuments, fat, and fascia, upwards for at least two inches, the assistant retracting the skin. Then the muscles are divided obliquely upwards to the bone, leaving only a small quantity of muscle on the anterior aspect ; the knife is swept round and between the bones, the flaps retracted, the bones sawn through, and the operation completed by securing the vessels, and bringing the flaps into apposition by sutures. When the operation is undertaken for disease, the muscular tissue is generally atrophied and not likely to be redundant, and the tendons being attached inferiorly, the flaps can be cut smoothly and evenly by transfixion, and without disturbance of the natural connection of parts. In performing the double-flap operation by transfixion, the arm being held between pronation and supination, the surgeon grasps the soft parts covering the sides of the forearm, and draws as much of them as possible towards the

posterior aspect of the limb, so as to obtain as broad and bulky a posterior flap as possible. He then transfixes the base of his flap from the radial towards the ulnar side of the limb, and in the case of the right forearm, from the ulnar towards the radial side of the left forearm, making his knife pass close to the posterior surfaces of the bones, and then carries it down so as to cut out a gently-rounded flap about $2\frac{1}{2}$ or 3 inches long. Again he inserts his knife in front, about half-an-inch lower than the former point of transfixion, and cuts a flap to correspond with the posterior one. Both flaps are then forcibly retracted, the knife applied so as to clear the bones at least an inch higher than the point of transfixion, the interosseous textures divided, the bones sawn through, and the operation completed as in the former method. Or the operator may make his second flap by cutting from the skin inwards. In either case, to facilitate the formation of the anterior flap, the assistant should supinate the forearm when the posterior flap is completed. In my own practice, I generally cut the posterior flap somewhat longer than the anterior (as represented in Plate xxxvi. Fig. 1), so that it may fold over the ends of the bone as the wound heals, and thus the cicatrix does not correspond to the end of the bones. The reason why the knife is entered lower down in transfixing for the second flap is to avoid cross-cutting the base of the first flap, which is otherwise almost certain to occur.

Amputation of the forearm by a long and short flap on Teale's principle, can be most readily performed as follows :—The forearm being held as formerly described, or slightly supinated, the surgeon, managing the soft parts as in the former case, transfixes in front of the bones, and carries his knife directly down close to the bones, without any inclination to the surface, for about four inches, he does not cut out at this point, but, drawing the knife back in the track of the incision for about two inches, turns its edge directly towards the surface, and cuts out there, so as to form a short square flap; then at the point where the longitudinal incision terminated he divides all the soft parts on the back part of the forearm with a decided circular sweep of his

knife, and separates the long square flap so marked out rapidly up to its base. The bones are then cleared and sawn through, and the operation completed, care being taken to adjust the angles of the flaps exactly to each other.

The vessels which require to be secured after amputation of the forearm are the radial, ulnar, and interosseous. The two first are easily seen and secured. The radial lies very superficial and to the outer side of the anterior flap. The ulnar is deeper, and in muscular limbs sometimes retracts a little, but the position of the ulnar nerve at once guides to the vessel. The posterior interosseous and its branches are seen on the posterior flap, but the anterior interosseous, which lies deep, is sometimes difficult to secure, as it retracts amongst the deep muscles. It should always be looked for and secured, as it may cease to bleed at the time of the operation, but is sure to bleed and give rise to trouble afterwards. In this operation, and indeed in all amputations, the nerves should be drawn out a little, and cut short, so as to prevent them becoming adherent over the bone, or in the cicatrix, as shown in Plate xxxiii. Figs. 1, 2, and so giving rise to a painful stump.

LECTURE LXXXVIII.

Amputations in the Upper Extremity *continued*—At the Elbow-Joint—Amputation of the Upper Arm by the Circular Method : by the Antero-Posterior and Lateral Flap Methods—Teale's Method—Amputation at the Shoulder-Joint : by a large Deltoid Flap ; by Double-Flap Method—Advantages and Disadvantages of each — The Author's own Method : its Advantages — Details of his mode of conducting the Operation—Amputation of Arm and Scapula.

AMPUTATION AT THE ELBOW-JOINT is seldom performed, because in the cases where it would be desirable we can rarely get a sufficiency of sound texture to form a covering for the large condyloid end of the bone. In a case in which I operated for the effects of an old burn, I had to form a long flap from the soft parts on the outer side of the forearm, and a flap from that position, or from the inner side, may occasionally be obtained in cases of recent injury, to enable us to get a covering. The preferable method, when we have the choice, is to cut a long flap from the anterior aspect of the joint, and a smaller one posteriorly, either by transfixion immediately below the condyles, and cutting towards the surface so as to form a long flap, as represented in Fig. 2, Plate xxxvi., and then dividing the soft parts on the back by a circular cut ; or by cutting a similar flap from the surface inwards, then opening the joint in front, dividing the lateral ligaments, and separating the attachment of the triceps to the olecranon process, so as to complete the removal of the forearm. The result of this method is shown in Plate xxxvi. Fig. 3. When the arteries are secured and the nerves cut short, the anterior flap folds over the condyles, and is easily maintained in position.

AMPUTATION OF THE UPPER ARM is perhaps the simplest of

Plate XXXVI

Fig. 1

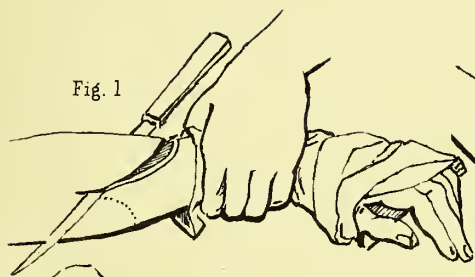


Fig. 2

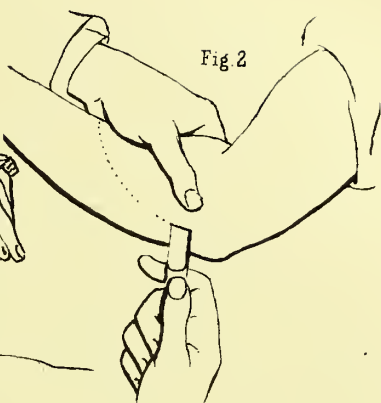


Fig. 4

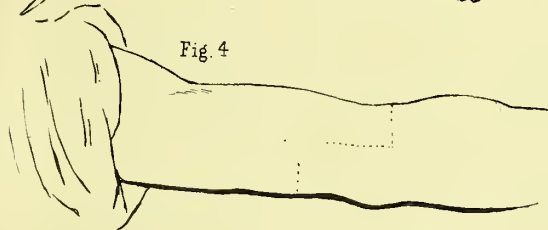


Fig. 5



Fig. 3



Fig. 6

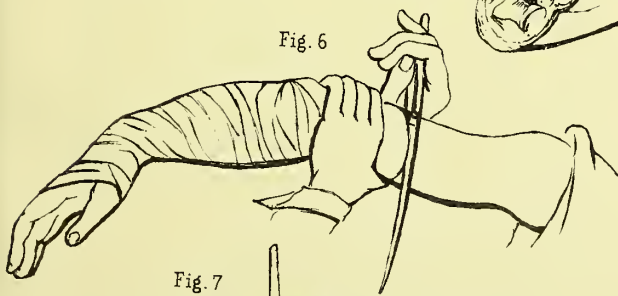


Fig. 8

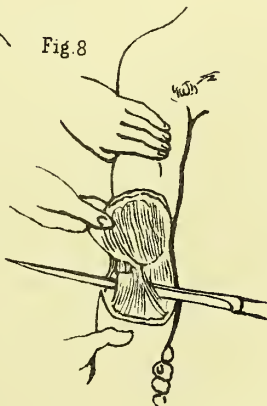
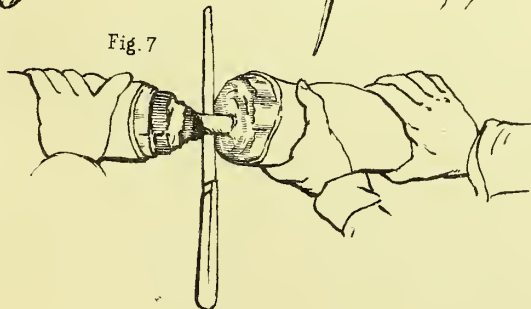


Fig. 7



all amputations. It may be effected with almost equal success by the old circular or the modified circular method, or by antero-posterior or lateral flaps. In performing the circular operation (Plate xxxvi. Figs. 6 and 7), the integument should be well drawn up by an assistant. The operator should then bend his right knee, place his hand and wrist well round the arm, and begin his incision in such a position that, by rising and cutting simultaneously, he can cause the cutting edge of the knife to traverse the circumference of the arm at one sweep. The skin, fat, and fascia, so cut, should then be retracted by the assistant, and the muscular and other textures cut through to the bone by a second circular cut. These should in their turn be drawn upwards, the muscles immediately surrounding the bone projected, and the edge of the knife applied obliquely, so as to convert the projection into a hollow cone. The soft parts are then held back so as to allow the bone to be sawn as high as exposed. Thus, when the soft parts are restored to their position, they form a hollow cone, of which the section of the bone forms the apex. When healed, the result is a well-covered and very useful stump. The antero-posterior or lateral-flap method is performed by means of transfixion (Plate xxxvi. Fig. 8). The soft parts should be grasped and pinched up by the left hand of the operator, so as to enable him to transfix with the blade of the knife close to the bone. He should then cut downwards and outwards through the muscles and skin, making a well-proportioned and neatly-rounded flap. After that has been effected, he should re-insert the knife half-an-inch below the former point of transfixion, close to the bone on the opposite side, and make a second flap to correspond exactly with the first. The flaps should be well retracted, and the bone cleared and cut at a point at least an inch and a half above the angles of the incisions, and the bone sawn through there. All further retraction must then be avoided, lest the periosteum be dragged up from off the divided bone. Many surgical authorities seem to consider it a matter of indifference whether this amputation be performed by antero-posterior or lateral

flaps. My own experience leads me to a different conclusion. I think that whenever the upper arm is to be amputated at or near the middle, the method by lateral flaps (external and internal) should be adopted in preference to flaps from the anterior and posterior aspects of the limb. In the former, the line of the base of the external flap crosses the line in which the divided humerus is raised by the action of the deltoid, and consequently the flap folds over the bone as it is raised. But if we adopt the antero-posterior flaps, the line of union of the flaps corresponds to that in which the end of the bone will be raised after section, and hence it is liable to be projected at the angle of incision. In fact, the lateral-flap method in this region has the same advantage that the antero-posterior flaps have in regard to amputation in the thigh.

Teale's method (Plate xxxvi. Figs. 4 and 5), by a long external and very short internal flap, answers admirably in cases of disease of the forearm, in which the muscles of the limb are atrophied, or the textures condensed by inflammatory exudation. I have performed it in several such cases with excellent results. The following is the method:—I grasp the soft parts on the outside of the arm, about four inches above the external condyle of the humerus, so as to separate them from the bone, and transfix there, taking care to include fully half the circumference of the limb, and then carry the knife downwards parallel to the bone, without inclining it in any direction, until it arrives at the condyle, when I turn its edge at a right angle to the skin and cut directly outwards, the assistant at the same time drawing up the skin. This long square flap is then held aside, and the soft parts on the inside of the arm divided with a single circular sweep of the knife, about an inch and a half below the point of transfixion, so as to form a short square flap, which is rapidly separated from the bone up to the base of the long flap. Both flaps are then retracted, and the bone cleared and sawn through about an inch higher up. The vessels are then secured, the nerves cut short, and the flaps carefully adjusted.

AMPUTATIONS.



Fig. 2

Fig. 4

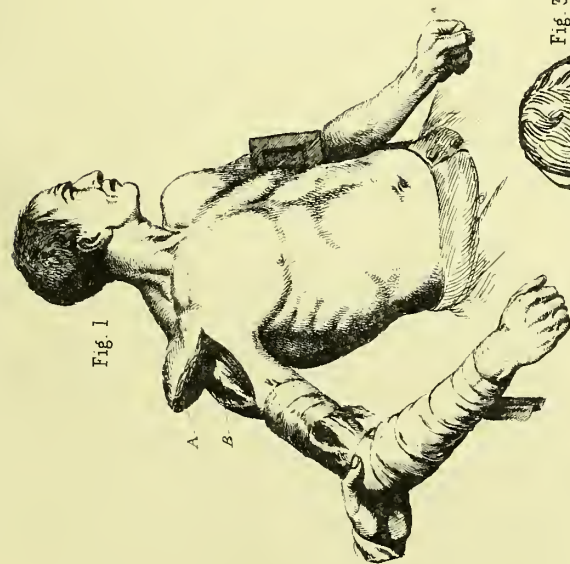
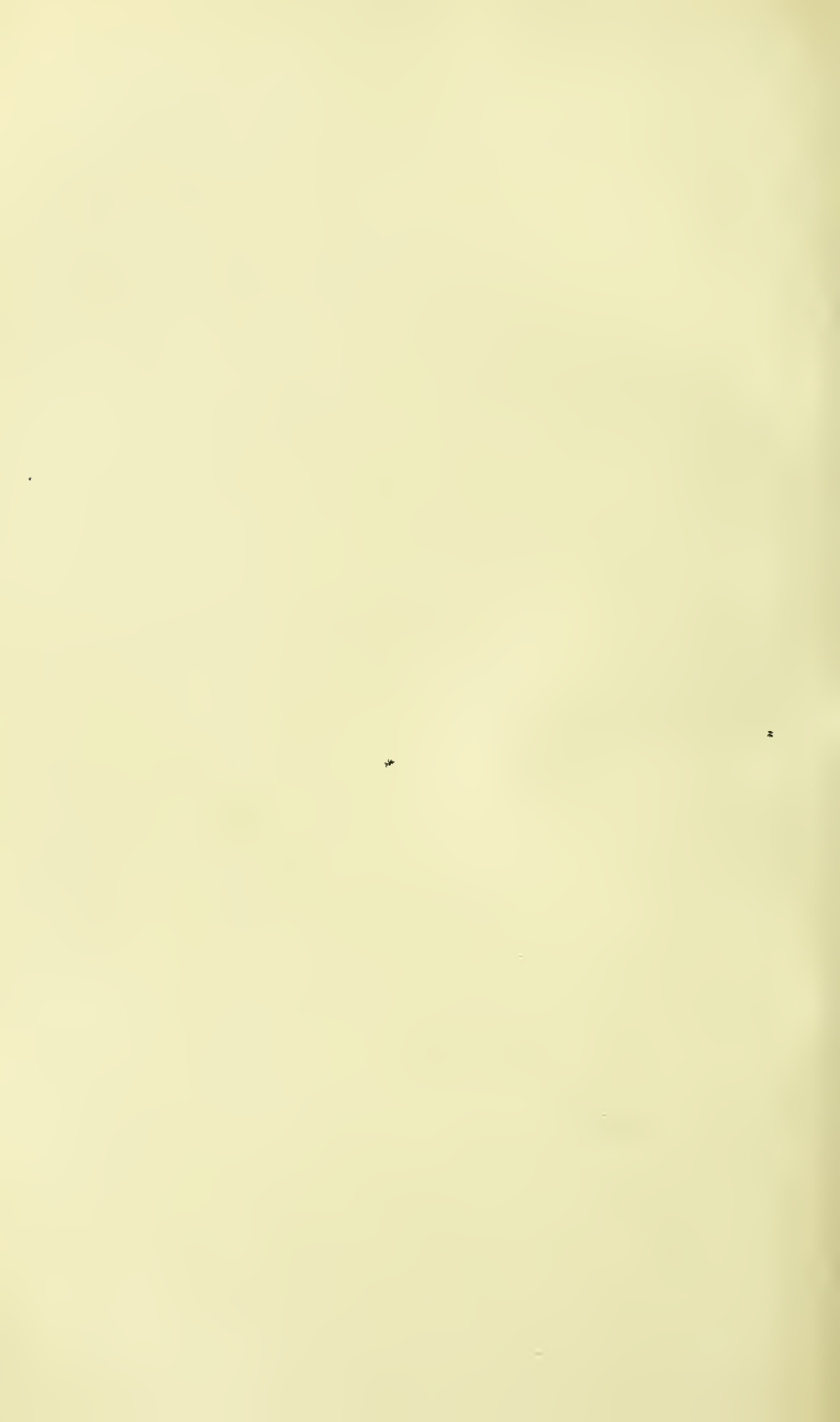


Fig. 1

Fig. 3





AMPUTATION AT THE SHOULDER-JOINT may be performed by various methods. The two which have hitherto been generally adopted are—amputation by a large deltoid flap, and that by two lateral flaps.

Amputation by a large Deltoid Flap consists in cutting, either by transfixion or from without inwards, a large flap, including nearly the whole of the deltoid muscle, the arm being somewhat abducted to enable the surgeon to grasp and cut the flap more easily. The flap is then raised towards its scapular attachments, so as to expose the joint (Plate xxxvii. Fig. 1). The assistant then pushes the arm forcibly across the body, so as to render prominent the head and tuberosities of the humerus. The surgeon cuts directly upon the tense capsule and tendons of the capsular muscles, so as to open the articulation; rotating the arm outwards and inwards to divide thoroughly any resisting fibres of the external rotator or subscapularis tendons, turns out the head of the bone from its socket, and passes the knife on the inner side of the bone to divide the soft textures in the axilla, and form a short flap to meet the deltoid. As the surgeon cuts out, the assistant grasps the lower flap between his fingers and thumb, so as to command the axillary vessels before they are divided (Plate xxxvii. Fig. 2).

The *Double-Flap* method consists in forming, either by transfixion or rapid dissection, two nearly equal and gently rounded flaps, one from the posterior, the other from the anterior aspect of the shoulder. When transfixion is adopted, the patient is brought close to the edge of the table and turned on his side. The affected limb is held somewhat abducted by the assistant, who stands on the opposite side of the table. If the left arm is to be removed, the surgeon introduces his knife from the posterior border of the axilla, passes it obliquely upwards over and close to the head of the humerus, and brings out the point opposite the centre of the acromion process, and cuts downwards so as to form a rounded posterior flap (Plate xxxvii. Fig. 3). The flap being raised, exposes the outer surface of the joint, the assistant draws the arm across the chest so as to project the head of the humerus,

and the operator divides the capsule and capsular tendons, disarticulates, and then places his knife on the inner side of the bone (Plate xxxvii. Fig. 4) and cuts the anterior flap. If the right limb is to be removed, the knife is introduced from under the point of the acromion, passed over the head of the humerus, and brought out at the posterior margin of the axilla to form the posterior flap. The vessels are commanded and the operation completed as already described.

This plan of operating is that generally adopted; for although the deltoid flap makes an excellent covering, and admits of great facility in disarticulation, yet the amount of exposed cut surface and the double line of cicatrix contrast unfavourably with the single central linear scar left by the double-flap method. Moreover, the great length of tissue required in the deltoid flap cannot often be obtained in cases requiring amputation at the shoulder.

As regards the method by double flap, if we look at the result of such an amputation when recently performed, especially if executed by cutting the textures from without inwards, nothing can look better;—the two flaps joining neatly in their central line, and sufficiently full to give roundness and to fill up the space under the acromion. But if we look at such a stump some time after the healing process has been effected, the form of the stump will be found much altered, not merely from atrophy of texture common to all stumps, but from retraction of the muscular constituents of the flaps. The fibres of the pectoralis major retracting towards the sternum, and those of the latissimus dorsi and teres major towards the scapula and spine, cause a separation, especially at the lower part of the line of union, and give rise to the formation of a deep ugly hollow under the acromion, as seen in the adjoining woodcut (Fig. 1).

In 1856, from a perusal of Professor Langenbeck's and M. Baudens' memoirs on excision of the shoulder for gunshot wounds, I was induced to adopt the method of excision by a single linear incision made down upon the head and neck of the humerus, beginning immediately external to the cora-

coid process, instead of the V-shaped incision then practised here. In performing the operation on the living subject, I was struck, not only by the ease with which disarticulation could thus be accomplished, but also by observing that, from the deltoid being divided so far forward, there was no trouble with bleeding from the trunk of the posterior circumflex artery, which in other methods is always divided and often proves troublesome. In demonstrating the operation to my class at that time, I pointed out that it possessed another advantage—namely, that if, in

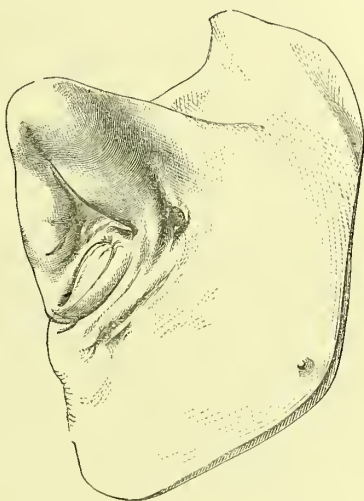


Fig. 1.

proceeding to excise the head of the humerus, the injury or disease were found to be more extensive than anticipated, we could form—by simply carrying the incision back towards the posterior fold of the axilla, as I then expressed myself—a very tolerable stump. But when, after performing the excision, I completed the demonstration by converting the excision into an amputation, it struck me that the result would be even better than that of the ordinary method. Accordingly I determined to adopt it on the first suitable case which I met with.

Some short time afterwards two cases of injury were sent to my care requiring amputation at the shoulder: one the result of a railway accident, shattering and tearing the upper arm; the other, a gunshot wound shattering the tuberosities and shaft. In these two cases I carried out the plan, and the result was so perfect in both that I have always since resorted to it in every instance where the nature of the case admitted of its performance. Indeed, the only instances in which I could not perform it have been two: the one a case of se-

condary amputation for a burn, in which, from the state of the textures, I was compelled to form the flap entirely from the front; and the other a case requiring amputation from the presence of a malignant tumour, to which the skin was adherent, and where only two very small flaps could be obtained from the sound textures.

What I have already said might almost indicate the method proposed. But to describe it more distinctly and fully.—Supposing the right arm to be the subject of amputation. The arm being slightly abducted, and the head of the humerus rotated outwards, with a broad strong bistoury I cut down upon the inner aspect of the head of the humerus, immediately external to the coracoid process, and carry the incision down through the clavicular fibres of the deltoid and pectoralis major muscles, till I reach the humeral attachment of the latter muscle, which I divide. I then with a gentle curve carry my incision across and fairly through the lower fibres of the deltoid towards, but not through, the posterior border of the axilla. Unless the textures be much torn, I next mark out the line of the lower part of the inner section by carrying an incision, through the *skin and fat only*, from the point where my straight incision terminated, across the inside of the arm, to meet the incision at the outer part. This ensures accuracy in the line of union, but is not essential. If the fibres of the deltoid have been thoroughly divided in the line of incision, the flap so marked out, along with the posterior circumflex trunk, which enters its deep surface, can be easily separated from the bone and joint, and drawn upwards and backwards so as to expose the head and tuberosities, by the point of the finger, without further use of the knife. The tendinous insertions of the capsular muscles, the long head of the biceps, and the capsule, are next divided by cutting directly on the tuberosities and head of the bone; and the broad subscapular tendon especially, being very fully exposed by the incision, can be much more easily and completely divided than in the double-flap method. By keeping the large posterior flap out of the way by a broad copper spatula or the fingers of an assistant, and taking care to keep the edge

AMPUTATIONS.

Plate XXXVIII

Fig. 1

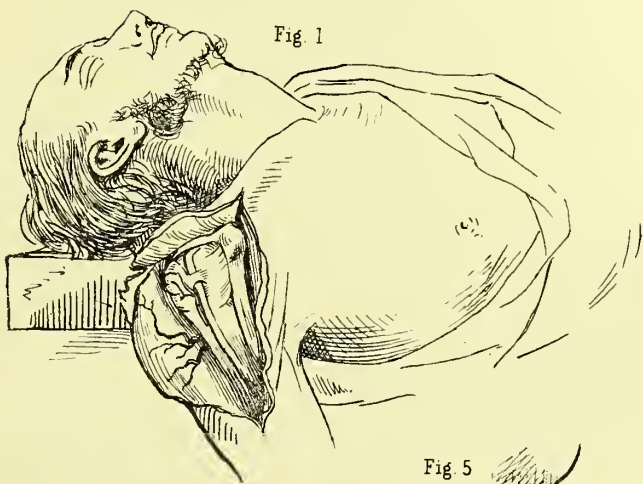


Fig. 2

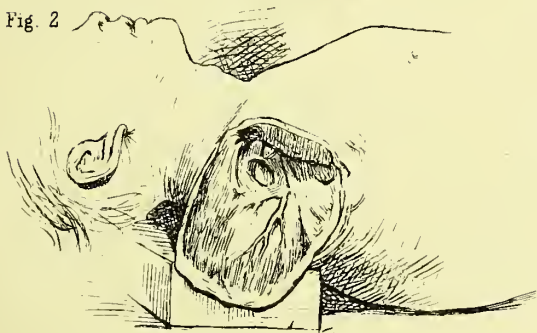


Fig 5



Fig 3

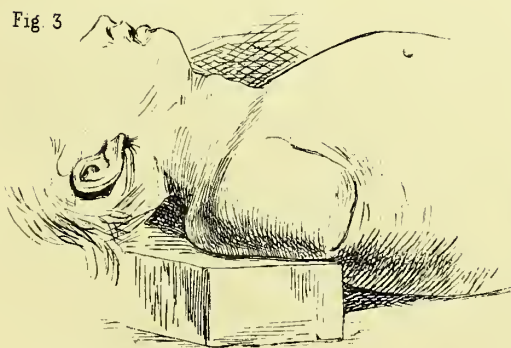
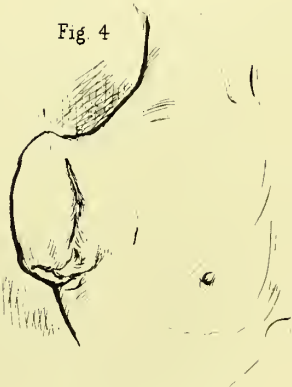


Fig 4



of the knife close to the bone, as in excision, the trunk of the posterior circumflex is protected. The only vessel which bleeds is the anterior circumflex divided in the first incision, and, if necessary, a pair of catch forceps can be placed on it at once. In regard to the axillary vessels, they can either be compressed by an assistant before completing the division of the soft part on the axillary aspect; or, to avoid all risk, the axillary artery may be exposed, tied, and divided between two ligatures, so as to allow it to retract before dividing the other textures.

In cases where the limb is very muscular, I dissect the skin and fat from the deltoid at the lower part, and then divide the muscular fibres higher up by a second incision, so as to avoid redundancy of muscular tissue. After arresting bleeding, I bring the edges together with a few points of suture, leaving an opening at the lower and back part, through which the ligatures are brought out and the free escape of blood and other discharge permitted.

The dressing I use is very simple, being merely a flat pad of lint secured by a six-tailed split cloth, the tails being tied on the opposite side of the body.

The advantages I claim for this plan are—1st. The fulness and better form of the stump left after the healing, as shown in the results (Fig. 2). 2d. The posterior circumflex artery is not divided except in its small terminal branches in front; whereas, both in the large deltoid flap and the double-flap methods, the trunk of the vessel is divided in the early steps

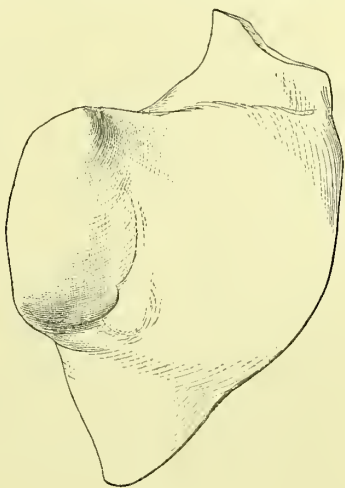


Fig. 2.

of the operation, and, retracting, often gives rise to embarrassing hæmorrhage. In the case of the deltoid single-flap method; the vitality of the flap must be seriously compro-

mised, as it depends chiefly on that vessel for its arterial supply. 3d. The great ease with which disarticulation can be accomplished.

In advocating the merits of any particular plan of operation, we should be careful not to risk its reputation by claiming superiority for it, under all conditions, over every other plan, or ignoring its disadvantages in certain circumstances. There are cases in which I would prefer the operation by double flap, such as those for malignant tumour, where we wish to remove all the muscular tissue of the deltoid, and leave nothing but skin-flaps. In these cases a single long flap dissected from the sub-jacent tissues, and depending entirely for nourishment on the vascular supply of its base, is more apt to slough than two smaller ones would be.

I may say, however, after considerable experience in amputation at the shoulder-joint, that there are few cases in which the method I have recommended will not be found suitable; and where it is so, I have no hesitation in advising it as being preferable to any other method I have ever practised.

AMPUTATION OF THE SCAPULA along with the arm is sometimes required in consequence of injury, or for tumours involving both the scapula and humerus, and the results of the cases in which it has been performed fully warrant it. In cases where the operation is necessitated, the surgeon must often require to modify his incisions, according to the position and connections of the disease, or the state of the injured parts. As a general rule, however, the operation is performed by dorsal and pectoral flaps from the axilla, to cover in the exposed surface. The posterior flap is marked out by making a lunated incision with its convexity directed forwards, commencing along the upper margin of the scapula and passing down over the acromion process to the lower border of the axilla, and again passing back towards the lower part of the base of the scapula. The anterior flap is next marked out by an incision commencing over the clavicle, about an inch nearer the sternum than the coracoid process of the scapula, and carried down over the front of the axilla to

its lower border, but there is no necessity for carrying this lower part of the incision towards the sternum further than to curve it slightly. The posterior flap is then to be dissected rapidly back, so as to expose the base of the scapula. The operator should then divide the integuments and humeral attachments of the pectoralis muscle in the line marked out for the anterior flap, and clear and saw through the clavicle on the sternal side of the coraco-clavicular ligament. This will enable him by a few touches of the knife to expose the axillary and supra-scapular vessels, and he can secure them at once, either by the assistant grasping them between his fingers, or, better, by tying them with double ligatures and dividing them. By this procedure the hæmorrhage from the great vessels and the sub-scapular and supra-scapular branches will be avoided. The flaps now being held aside, the attachments of the trapezius to the scapula are divided. The scapula and arm are drawn outwards by the assistant, and the scapular attachments of the serratus magnus, rhomoid, and levator anguli scapulæ muscles being stretched, are severed by a stroke of the knife, and the operation completed. The artery of the base of the scapula will be now divided and require ligature. Some advise that when the base of the scapula is exposed by dissecting the posterior flap, the muscles attaching the scapula to the trunk should be divided, the arm and scapula thrown forwards, the clavicle sawn through or disarticulated, and the anterior flap formed in cutting out. I prefer the method I have described, specially as preventing loss of blood as far as possible, but also because the division of the scapular attachment of the serratus is more easily accomplished after the clavicle is sawn through, and the scapula drawn from the side. Removal of the scapula alone, for tumours, will be considered when treating of operations in the axillary region.

LECTURE LXXXIX.

Special Amputations *continued*—Lower Extremity—Amputation of the Phalanges of the Toes : of the Phalanges of the great Toe with or without its Metatarsal Bone—Partial Amputations of the Foot ; of all the Toes : Hey's Operation ; Chopart's Operation—Amputation at the Ankle : by Syme's Method ; by a large Internal Flap—Other Modifications.

THE amputations of the lower extremity are performed on the same principles as those of the upper, but require to be modified in respect of form, and uses of the part left. The dotted lines on the plantar and dorsal aspects of the foot in Figures 1 and 2, Plate xxxix., indicate the lines of incision generally adopted in amputation of the toes, and partial amputations of the foot.

AMPUTATION OF THE PHALANGES OF THE TOES may be necessitated by a variety of causes, such as injury, cario-necrosis, exostosis, onychia maligna ; or by the toe having become so distorted as to interfere with progression. In the last-mentioned condition I have frequently saved the toe by dividing the flexor or extensor tendons, and other resistant tissues, so as to straighten the toe ; but the after-treatment of such operations is often tedious and troublesome, so that amputation affords a more rapid cure and equally good result, so far as the use of the foot is concerned.

AMPUTATION OF THE TOE is, or should be, always performed at the junction of the phalanges with the metatarsal bone. The lines of incision, and the mode of procedure, are the same as in the corresponding amputation of the finger ; only we must recollect that the joint lies further removed from the web between the toes than the metacarpo-phalangeal joint of the fingers. The amputation is accomplished thus :—The point of the bistoury is

inserted over the middle line of the toe to be removed, half-an-inch above the joint, carried down, gradually diverging to one side as it approaches the web, and is carried through that into the sole of the foot. From the plantar aspect it is carried upwards, on the opposite side of the toe, converging into the original incision. The strong flexor tendons on the plantar aspect of the toe are divided, the lateral ligaments cut with the point of the knife, and disarticulation effected. When the bleeding is arrested, and the adjoining toes are closely approximated, the loss of the toe is scarcely perceptible. The key to easy disarticulation of the toe is complete division of the strong flexor tendons, and, to effect this at once, I extend the toe forcibly upwards so soon as the incisions of the soft parts are completed; and this enables me to twist the toe so as easily to open the joint and divide the lateral ligaments.

In performing AMPUTATION OF THE PHALANGES OF THE GREAT TOE, we require to save all the integuments we can, to cover in the large distal extremity of the metatarsal bone, and with this view we take care not to make the incision diverge laterally till it has passed for some distance beyond the articular end of the proximal phalanx, or we even carry the incision directly down to near the middle of that phalanx, and then cut circularly round the toe, thus marking out two square flaps of skin. In either mode the internal flap requires to be dissected, the texture forming the web on the outer side divided, and then the flexor tendon cut, and disarticulation accomplished, as in the other toes. The sesamoid bones may require to be removed along with the phalanges. No part of the articular surface or extremity of the metatarsal bone of the great toe should be removed with a view to neatness of the stump, as it forms the anterior extremity of the antero-posterior arch of the foot, and its removal seriously injures both progression and the support which the arched form of the foot affords.

When injury or disease necessitates AMPUTATION OF THE META-

TARSAL BONE OF THE GREAT TOE, along with its phalanges, the longitudinal incision may be made either on the dorsal or internal aspect of the foot, and carried down to its phalangeal articulation, when it is made to diverge, as in the amputations of the phalanges. If partial removal of the bone is contemplated, its section is accomplished, at a healthy point, by means of strong bone-pliers. If disarticulation of the whole bone is necessary, then the incision must commence fully three-fourths of an inch above the articulation between the metatarsal with the internal cuneiform bone. The form of the articulation must be kept in mind. It is not broad, but very deep from the dorsal towards the plantar aspect of the foot, and is most easily opened by cutting the lateral ligaments on the inner side, then inserting the knife perpendicularly, with its edge directed upwards, between the first and second metatarsal bones, so as to divide the strong interosseous ligamentous structure. When this is done, and the great toe and its metatarsal bone forcibly drawn inwards, the disarticulation is most easily effected. Great difficulty has often been met with in arresting the bleeding after partial amputation of this metatarsal bone. This arises from the terminal branch of the dorsal artery being wounded, as it passes down between the first and second metatarsal bones to join the plantar arch. The vessel is wounded, not divided completely, and cannot be seized with the artery forceps, or, when seized, the ligature cannot be tightened in the narrow space between the bones. In some cases I have managed to pass a double ligature by means of an aneurism needle, drag the vessel up and secure it; but in one instance I had to disarticulate the remaining portion of the bone before the vessel could be secured above and below the wounded point, and this has been required in other cases; whilst there have been fatal results from repeated hæmorrhage, when compression has been trusted in to arrest the bleeding. For my own part, I see no great advantage in leaving a small portion of this metatarsal bone, as the articulation is on a line anterior to, and does not communicate with, the other tarso-metatarsal joints; and, when complete disarticulation is per-

Plate XXXIX

Fig. 1

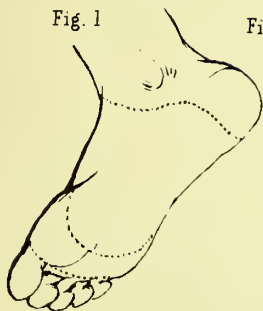


Fig. 2



Fig. 3



Fig. 4



Fig. 5



Fig. 6

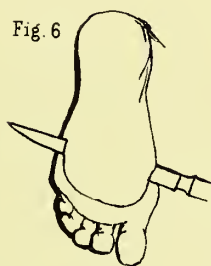


Fig. 7



Fig. 8



Fig. 9

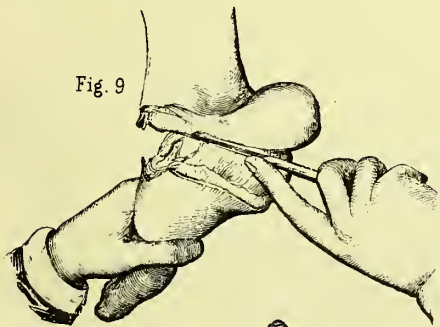


Fig. 10

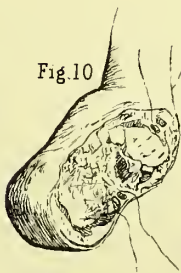


Fig. 11



Fig. 12

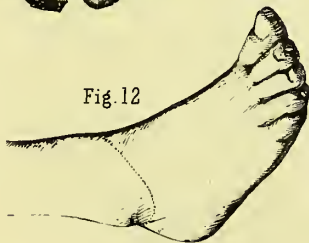
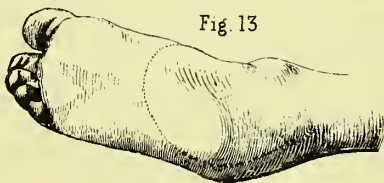


Fig. 13



formed, there is no difficulty in seeing and dealing with the wounded artery.

PARTIAL AMPUTATION OF THE FOOT may be performed at different points, and, like the partial amputations of the hand, the operation must be modified according to the circumstances requiring its performance. But, besides the irregular amputations, there are certain amputations of the foot which may be considered as regular operations, such as, amputation of all the toes at the metatarso-phalangeal articulations, Hey's amputation at the junction of the tarsus with the metatarsus, and Chopart's amputation at the joint, between the scaphoid and cuboid, with the astragalus and calcaneum.

AMPUTATION OF ALL THE TOES, at their junction with the metatarsus, is best accomplished by shaping a short skin flap from the dorsal aspect of the joint, and a larger plantar flap, as represented in Plate xxxix. Fig. 5, and effecting disarticulation by opening the joints from the inner side of the left and the outer side of the right foot, after dividing freely the textures on their dorsal and plantar surfaces. Owing to the division of the digital branches, a great number of arteries require to be tied in this amputation.

Partial amputation of the foot, leaving the great and second toes, and removing the other toes with their metatarsal bones, or even removal of all the toes and metatarsus with the exception of the great toe, leaves a very useful foot. The flaps must be cut from without inwards, and must be so shaped that a large somewhat triangular flap from the plantar region is obtained to cover in the tarsal range and outer aspect of the metatarsal bone of the great toe, and a smaller dorsal flap to meet it. In two instances I have removed the two outer cuneiform bones and anterior surface of the cuboid, leaving the great toe; and when the wound was healed, and a well-stuffed boot worn, the movements of the foot, after a time, seemed as free as those of the opposite one. When the great and second toes require to be

removed, Hey's amputation is preferable to leaving the two or three outer toes, as they gradually curve obliquely inwards, and impede instead of assisting progression.

PARTIAL AMPUTATION OF THE FOOT AT THE TARSO-METATARSAL ARTICULATION was first proposed by Hey of Leeds. As performed by him, disarticulation of the metatarsus having been accomplished as far inwards as the internal cuneiform bone, the projecting part of that bone was sawn off, and the foot removed. Lisfranc's modification of the operation consists in disarticulation throughout the whole range of the articulations. It is advisable for the student to practise Lisfranc's method on the subject, so as to gain dexterity in disarticulation. But, in operating on the living, I would advise Hey's method, in respect that it is at once easier in execution, and leaves a better stump, by removing the projecting end of the internal cuneiform. The objection, that by doing so we destroy the attachments of the *tibialis posticus* and *anticus*, is merely fanciful. These tendons and their expansion are attached to the whole extent of the internal cuneiform bone.

As regards the incisions, they are the same in both methods. The surgeon grasps the foot with his left hand, placing his forefinger and thumb, the one well behind the projection of the metatarsal bone of the fifth toe, the other over the base of the metatarsal bone of the great toe, thus marking the general line of the articulation. He then cuts obliquely, from without inwards in the left foot, and from the opposite direction in the right foot, across the integument on the dorsum of the foot, an inch and a half in front of or below the articulation, and by a few touches of the knife frees it so that it can be retracted beyond the joint. Next he shapes a large flap from the plantar region. This flap should be longer on the inner than on the outer side, gently rounded off at its extremity, and should contain all the thickness of the plantar textures. Next, the operator disarticulates, by cutting from the fifth metatarsal bone inwards, until the knife is arrested by the head of the

second metatarsal bone. Instead of trying to get round that, he attacks the articulation between the internal cuneiform and first metatarsal, by opening it from the inner side. He then plunges his knife perpendicularly between the first and second metatarsal bones with its edge directed upwards, and moves it backwards and forwards till he feels the strong interosseous ligament give way. He then forcibly depresses the part to be removed, and, with a few touches over the head of the second metatarsal bone, the joint is opened, and disarticulation accomplished.

In Hey's method, after disarticulation is so far effected, the saw is applied to remove the projection of the internal cuneiform bone, and thus a more regular surface is left, and the operation much simplified. The plantar flap may be made by transfixion (as in Plate xxxix. Figs. 6 and 7); but I recommend it to be cut as I have described, as we can then shape it more accurately. The dorsal and plantar arteries require ligature, and also, in general, numerous branches springing from the arch. Some surgeons trust almost entirely to the plantar flap for a covering, but, to say nothing of the impossibility of always obtaining so long a plantar flap, I think it better that the cicatrix should be rather over the surface of the stump, where it will be opposed to the soft padding, than on the dorsum of the foot, where it will be exposed to the pressure of the boot.

Chopart's amputation consists in removal of that portion of the foot which lies anterior to the astragalus and os calcis. The general method of procedure and form of the flaps are very similar to that just described. The plantar flap requires to be very long internally, to fold over the exposed articular surface, which is very deep. The disarticulation, however, is very simple as compared with that at the tarso-metatarsal joint; for although, anatomically speaking, the line of articulation between the astragalus and scaphoid is slightly curved, and that between the cuboid and os calcis oblique from within outwards and forwards, yet practically, as regards disarticulation, when the anterior part of the foot is depressed, the articular surfaces sepa-

rate so that the line becomes almost transverse from side to side. The operation is performed as follows :—The surgeon ascertains the position of the scaphoid bone, by feeling its projection towards the plantar surface of the foot, and if operating on the right foot places his forefinger upon that point, whilst his thumb rests about three-fourths of an inch behind the projection of the fifth metatarsal bone. He makes a gently curved incision, the convexity towards the toes, across the dorsum of the foot, about an inch and a half in front of the joint, and separates the skin-flap with a few touches of his knife, whilst the assistant retracts it. He next forms the plantar flap, by cutting from without inwards, and then opens the joint from its external aspect, and completes the operation by disarticulating; or he may, after forming the dorsal flap, disarticulate by depressing the foot forcibly, and cutting up on the joint, and then pass the blade of his knife beneath the bones, and cut out the plantar flap, as represented in Hey's amputation in Plate xxxix. Fig. 7; but, as I have already said, I prefer shaping and cutting the plantar flap from without, before disarticulating.

Chopart's operation is one which I never perform now. I used to perform it before amputation at the ankle was introduced; but, though much preferable to amputation through the leg, it never left a very useful stump, and I consider it far inferior to amputation at the ankle. The gastrocnemius and soleus muscles having nothing to counteract them, draw up the heel; and hence the patient does not rest on the heel but on the fore part of the stump. Again, if the amputation be performed for disease of the tarsus, we leave the two bones which should of all others be removed, as being likely to partake of diseased action, and subsequently require another operation for their removal. If you ever do this operation, I would advise you to divide the tendo Achillis at the same time. You would thus equalise the balance between the muscles on the front and back, until adhesion of the divided tendons of the leg had taken place, and so you might prevent retraction of the heel.

AMPUTATION AT THE ANKLE-JOINT is, both in regard to safety and the formation of a useful stump, perhaps the most successful of all amputations. It may be performed either by Mr. Syme's method, or by a large internal flap ; and when the stump is fairly healed, it is very difficult to tell which method has been used—the result is so similar. Mr. Syme's method, as described by himself, is as follows:—"When the operation is to be performed, pressure should be made on the tibial arteries by the fingers of an assistant, or a tourniquet applied above the ankle. The only instruments required are a knife, of which the blade should not exceed four inches in length, and a saw. The foot being held at a right angle to the leg, the point of the knife is introduced immediately below the malleolar projection of the fibula, rather nearer its posterior than anterior edge, and then carried across the bone (sole ?), slightly inclining backwards, to the inner side of the ankle, where it terminates at the point *exactly opposite* its commencement. The extremities of the incision thus formed are then joined by another passing in front of the joint. The operator next proceeds to detach the flap from the bone, and for this purpose, having placed the fingers of his left hand over the prominence of the *os calcis*, and inserted the point of his thumb between the edges of the plantar incision, guides the knife between the bone and nail of the thumb, taking great care to cut parallel with the bone, and to avoid scoring or laceration of the integuments. He then opens the joint in front, carries his knife outwards and downwards on each side of the astragalus, so as to divide the lateral ligaments, and thus completes the disarticulation. Lastly, the knife is carried round the extremities of the tibia and fibula, so as to afford room for applying the saw, by means of which the articular projections are removed, together with the thin connecting slice of bone covered by cartilage. The vessels being then tied, and the edges of the wound stitched together, a piece of wet lint is applied lightly over the stump, without any bandage, so as to avoid the risk of undue pressure in the event of the cavity becoming distended with blood, which would be apt to occasion sloughing of the flap. When recovery

is completed, the stump has a bulbous form, from the thick cushion of dense textures that covers the heel, and readily admits of being fitted with a boot."—(See Plate xxxix. Figs. 1, 2, 9, 10, and 11.)

AMPUTATION BY LARGE INTERNAL FLAP (Plate xxxix. Figs. 12 and 13) is performed as follows :—Suppose the right foot is to be removed, it is held firmly, resting on its outside. The surgeon inserts his knife over the tendo Achillis, and cuts obliquely across that tendon towards the outer and plantar aspect of the heel, then curves his incision inwards across the sole of the foot, and then upwards in front of the internal malleolus, till it crosses the tendon of the tibialis anticus, so as to form the large internal plantar flap. Next, without removing his knife from the incision, he continues to cut across the dorsal aspect of the foot, about an inch below the ankle, until the incision terminates at the point where he commenced the operation. The flaps are then rapidly dissected up, taking care to avoid injuring the posterior tibial artery. Finally, disarticulation is accomplished, a section of the tibia and fibula removed as in Syme's method, and the vessels secured. When the patient rests on his side, the flap lies in position almost by its own weight, and any serous or other discharge escapes very readily, so that the stump generally heals more quickly and solidly than when the other plan is adopted, in which discharges are apt to accumulate in the heel-flap. To obviate this, Mr. Syme used at one time to make a counter opening, to allow free escape. That, however, is unnecessary, for if, after Syme's operation, the patient be made to rest on his side instead of being laid on his back, the discharges will escape at the fibular angle of the incision, which should be left a little open.

Various modifications of amputation at the ankle have been proposed, such as leaving the upper portion of the astragalus, in connection with the malleoli, instead of disarticulating it. Piri-goff's amputation consists in making the incisions somewhat in the same way as in Syme's method, except that the line of the plantar flap is well in front of the malleoli. After dissecting

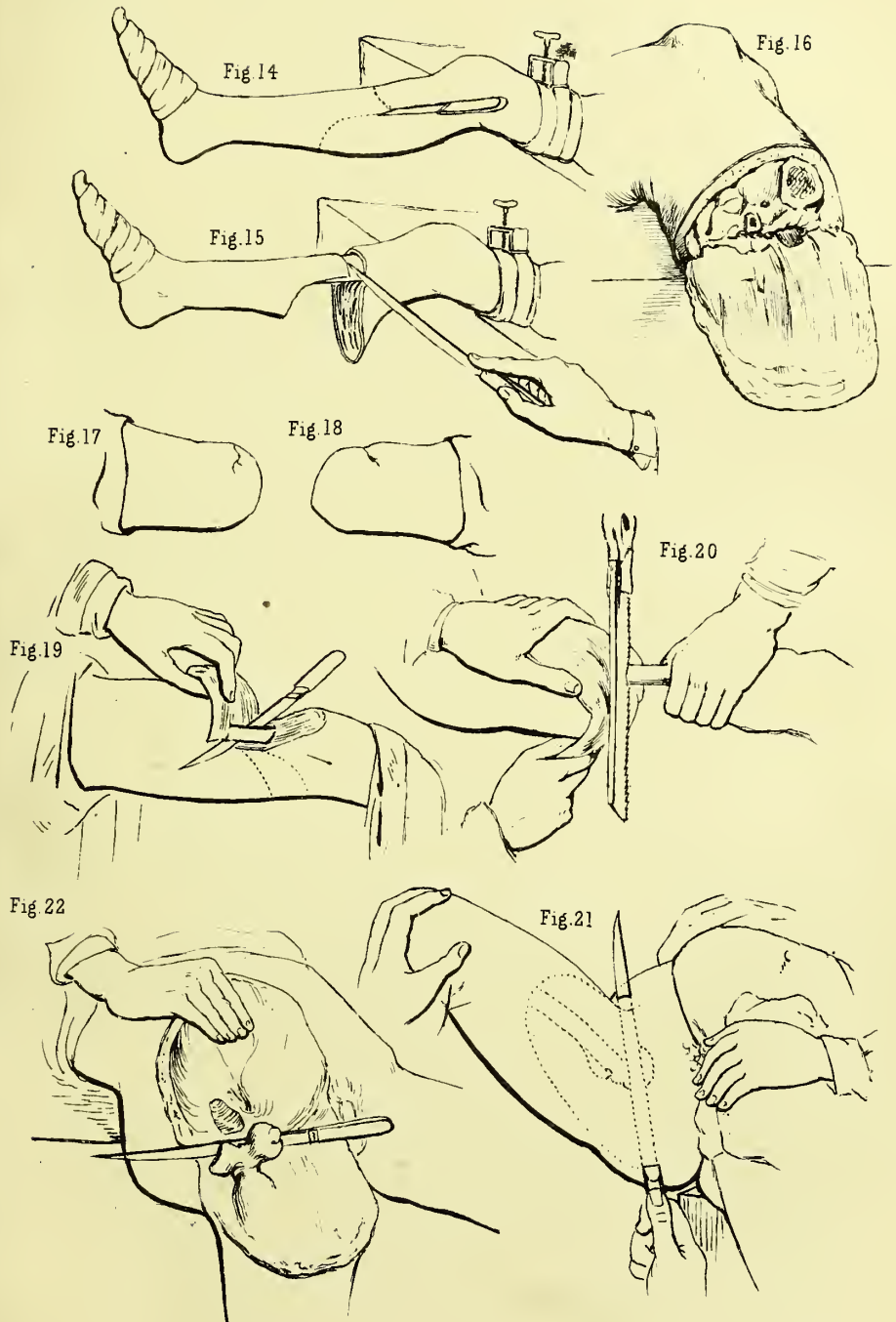
this flap beyond the line of the joint, but not from the heel, he disarticulates, and next saws through that part of the os calcis behind the joint, then saws off the ends of the tibia and fibula, as in the other methods, and applies the section of the calcaneum, retained in the plantar flap, to the section of the tibia and fibula, so that the osseous surfaces may unite. From what I have seen of such modifications, I consider them as anything but improvements on either of the methods I have described ; because they retain portions of bone, which, in cases of caries, have a predisposition to become, if they be not already, affected by the disease, and because the stump left is by no means so well fitted to support the weight of the body, nor so well adapted for progression.

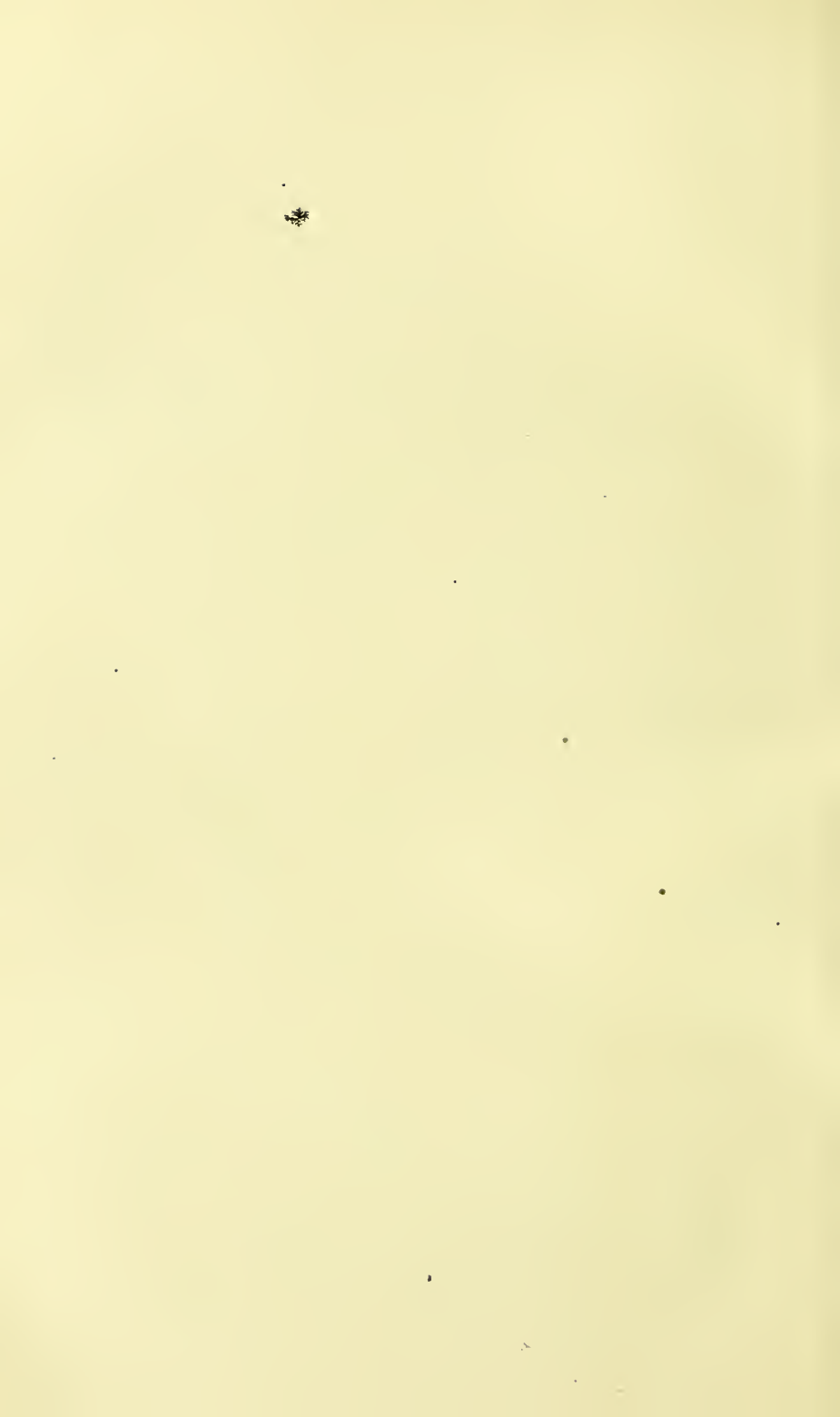
LECTURE XC.

Amputation of the Leg : Primary and Secondary ; by the Circular Method ; by long Posterior Flap ; by Teale's Method—Amputation at the Knee-Joint—Amputation at the Thigh by transfixion : by long Anterior Flap ; Author's Method ; by Circular Method—Amputation at the Hip-Joint : Advantages Steps of the Operation—Artificial Limbs.

AMPUTATION OF THE LEG may be performed either by the modified circular method, or by the long posterior flap, or by Teale's method of a long anterior skin flap. When the operation is performed for chronic disease, the muscles of the calf are generally atrophied and somewhat condensed ; and, in such cases, the long posterior flap method is, I consider, preferable to any other, as affording a well-covered stump on which the weight of the body may rest ; and the patient is thus enabled to walk with ease. This plan of operating, and its results, are shown in Plate xl. If the right leg is to be amputated, the operator stands on the inner side of the limb, places the heel of his knife over the outer margin of the fibula, carries the blade across the front of the leg until the point reaches a little behind the inner edge of the tibia. He then, without moving the point from the incision, transfixes the limb, and cuts out a long gently-rounded flap from the calf of the leg. The skin and flap are retracted, the bones cleared and sawn through a little higher than the point of transfixion. The point of election for section of the bones should be very little above the middle of the leg. In young patients or females, where there is a considerable amount of fat, a flap of skin may be obtained, by cutting from without inwards, and the limb removed near its lower third ; but the cases requiring amputation of the leg seldom admit of the operation being performed lower than the middle of the leg.

In sawing the bones, it is sometimes recommended to remove





the anterior angle formed by the section of the tibia, by first sawing the tibia obliquely before sawing it through ; but I have found this to expose the bone too high beyond the section, and now, when I find the angle very acute, I remove it, after section, either with the bone-pliers or a small saw. A good deal has been written about the difficulty of transfixion in this operation, and the risk of passing the knife between instead of behind the bones ; but, with ordinary care, and keeping in mind the oblique position of the fibula in relation to the tibia, there should be little risk of such an occurrence. I have never felt any difficulty, nor have I ever seen it happen, even with students practising the operation on the subject.

In cases of primary amputation of the leg, or when the muscles of the calf are largely developed, the transfixion method is objectionable, owing to the redundancy of muscle left not only preventing the parts being brought and kept in position, but as leading to tension and suppuration, and increased risk to the patient. This result is depicted in Plate xxxiii., from a sketch taken by the late Sir Charles Bell to show the disadvantage of the flap method. In such cases I have occasionally made my assistant retract the skin, and then removed the redundant muscle with a single stroke of the knife. Still, in primary amputations, I prefer the modified circular method, or rather a short anterior and longer posterior flap of skin cut from without inwards, a very small amount of muscle only being retained near the bones. The soft parts are then retracted fully, and the bones sawn higher up. In this amputation, when performed high up in the leg, difficulty is sometimes encountered in securing the posterior tibial artery. It retracts amongst the deep muscles, and cannot be readily seen or secured. In such circumstances, the best plan is to divide the interosseous membrane, and dissect so as to expose and tie the vessel. In the after-treatment of the stump, the patient should be made to lie on his side, which tends to obviate the pressure of the tibia on the anterior skin flap, and also allows the posterior flap to lie better in position to the bones.

The method of a long anterior skin flap proposed by Mr. Teale I do not consider to be well suited to the leg. I have tried it in one or two cases, but its result is not equal to the long posterior flap, and there is a greater risk of the tibia causing ulceration; and the long thin flap is liable to suffer from want of vascular supply.

AMPUTATION AT THE KNEE-JOINT, when we have an opportunity of performing it, in proper cases, should always be done in preference to amputating higher up. The difficulty is, that from the great bulk of the articular surface of the femur, we can seldom, in cases of injury, obtain a sufficiency of soft parts for a covering. The operation is performed by cutting a long and broad anterior flap of skin, beginning below the tuberosity of the tibia, and dissecting it up, removing the patella. Next, we divide the integuments on the posterior part of the limb, a little higher up, and when the skin is retracted for about two inches, the remaining soft parts in the popliteal space are divided obliquely towards the posterior surface of the joint. Then the knee is forcibly bent, the ligamentum patellæ, lateral, crucial, and posterior ligaments, divided, and disarticulation of the leg completed, the vessels secured, and the flaps adjusted and retained by sutures.

When considering the general subject of amputation, I took **AMPUTATION OF THE THIGH** as the example of the different methods of operating; and hence, as these have been already fully described, as regards the principles on which they are performed, I need do no more than very briefly describe the manual procedure adopted in the principal methods.

Amputation by double flaps, formed by transfixion.—The flaps should always be anterior and posterior, and are formed thus:—The operator stands on the inner side of the right and the outer side of the left limb, so as to command the bone whilst sawing it. An assistant, standing on the opposite side, places the palm of his hand against the posterior part of the thigh, at the part to

be operated on, so as to press upwards the soft parts, and relax those on the anterior aspect of the limb, to enable the operator to grasp and raise them from the bone, and thus to transfix with greater ease and obtain a broader flap. The limb below the knee is to be in this, as in all amputations, firmly supported by an assistant, seated in front of the patient. The surgeon transfixes the thigh, about an inch and a half below the point he intends to saw through the bone, and cuts out a broad and rounded flap, re-inserts the knife an inch lower than the first point of transfixion, and cuts the second flap from the posterior part of the thigh. Both flaps are retracted, and the assistant supporting the limb raises it a little, to cause the bone to be projected fully. Then the point of the knife is used to clear the bone higher up, and the saw applied to the highest point where the bone is exposed, and close to its attachments to the soft parts. So soon as the bone is sawn through, the assistant must avoid further retraction of the flaps, lest the periosteum be dragged upwards, and leave the bone denuded. The arteries are then tied: the femoral, at any point below the middle of the thigh, will be found on the surface of the posterior flap, towards its inner side, the vein lying behind it; the terminal branch of the profunda will be found close to the posterior surface of the bone and rather to its outer side. The muscular and cutaneous branches, often very numerous, must be tied where they are seen to jet or ooze. The flaps are then cleansed, placed and retained in apposition by sutures, and supported by compresses of lint, and a roller, to support the flaps; the line of incision over the end of the stump, being left uncovered. As regards the relative length of the flaps—in Mr. Liston's method the anterior flap is the shorter, and the posterior is cut long, to allow for its greater retraction to equalise the length of the flaps after the operation is completed. The line of his incision for the posterior flap is shown by the lower dotted line in Figure 19, Plate xl. The modification of Liston's plan which I used to practise before adopting the long anterior flap, and which I still practise in some cases, is to cut the anterior flap longer than the posterior. The

upper curved dotted line, in the plate already referred to, represents my line for the posterior flap. The anterior flap is thus drawn more over the end of the femur after cicatrisation of the stump.

X I have already fully described my method by the long anterior flap, and given my reasons for adopting it. The manual procedure is as follows :—The limb being held as in the other methods, the surgeon standing on the inner side of the right, or on the outside of the left limb, measures with his eye the breadth of half the circumference of the thigh, inserts his knife into the side of the limb, immediately above the outer or inner condyle, according as he is operating on the right or left thigh, carries the incision down to below the lower margin of the patella, sweeps the knife across the front of the knee with a gentle curve, and terminates the incision on the opposite side of the limb, on a level with the point where he entered his knife at first. The large flap, so marked out, is dissected rapidly upwards from off the patella and front of the joint. On clearing the upper margin of the patella, the surgeon cuts deeply and obliquely upwards, so as to retain muscular structure, and as much thickness of substance as possible in the upper part of the flap. He then applies the edge of his knife to the textures on the posterior aspect of the limb, about two inches below the base of the anterior flap, and divides them obliquely to the bone. The soft parts are then retracted, and the femur sawn through just above the condyles ; the vessels secured and flap retained by stitches ; but there is no need to apply any bandage or dressing ; all that is required is to pin a handkerchief across the thigh, to prevent jerking of the stump.

7 CIRCULAR AMPUTATION OF THE THIGH is so exactly similar to the same operation in the upper arm, that it need not be further described here. The modification of the circular method proposed by Mr. Syme, will be found fully described in Lecture lxxxiii. page 745.

AMPUTATION AT THE HIP-JOINT is undoubtedly one of the most formidable operations of surgery, and demands for its proper performance decision and rapidity in operating. The idea seems lately to have entered some minds, that the shock will be diminished if amputation through the trochanters be first performed, and then the head of the bone dissected out and disarticulated. I can hardly conceive anything more likely to increase shock than a prolonged operation, or rather double operation ; and the difficulty of dissecting out the head and neck of the femur, after section through the trochanters, is very great. In one of my own cases, I was unwillingly obliged to disarticulate after this fashion, the shaft being separated at the trochanters by diseased action ; and I found it by no means an easy matter, as it is difficult by any artificial means to compensate for the loss of the leverage of the thigh-bone. Certainly, rapidity of execution does not seem to increase shock, for of my three successful cases—In one, disarticulation was performed in ten seconds ; in another, in fifteen seconds ; and in the primary amputation, which was more complicated, it was effected in less than thirty seconds. I think the proposal I have alluded to must have arisen from confounding two things which are essentially different. It is quite true that in cases where amputation has been previously performed at the upper part of the leg or through the thigh, and in which, at some subsequent period, return of the disease has necessitated amputation at the hip-joint, the risk and shock are very much diminished, and the reasons for this are obvious ; but that is a very different thing from performing first one and then a second operation at the same time, with a view to diminish shock.

I have no hesitation in saying, that from my own experience, rapidity of execution in this operation is of great importance, as diminishing the risk from shock and loss of blood ; and in cases of tumours, where we have the leverage of the whole limb, the disarticulation may be accomplished in from ten to thirty seconds. The chief things to be attended to for its rapid (not hurried) performance are,—attention to the position of the patient ; that

the hip projects well over the table, whilst the pelvis is kept firmly secured, so as to prevent the body receding: this allows the limb to be fully depressed after the anterior flap is formed, and also facilitates the other movements necessary for enabling the knife to be passed readily beyond the trochanter major, so as to cut the posterior flap. The direction given to the knife in passing it across the front of the limb to form the anterior flap is all-important as to the ease with which the subsequent steps will be accomplished.

Operation.—In operating on the right limb, the surgeon, standing on the inside of the limb, which must be abducted, and slightly flexed on the pelvis, should enter the knife immediately in front of the tuber ischii, and carry it steadily in an oblique direction across the front of the joint to a point nearly midway between the great trochanter and crest of the ilium, and cut a rounded flap of sufficient length from the anterior surface of the limb. In doing this, great care must be taken to make the knife pass close in front of the head of the femur, and to turn its edge obliquely towards the joint; so that, when the flap is formed and raised, the capsule will be found to be opened, and when the limb is forcibly depressed, the head of the femur either at once starts out, or a single cut upon it divides the remaining portion of the capsular and round ligaments. Then nothing remains to be done but to clear the trochanter major, and form a posterior flap, somewhat shorter than the anterior.

The hæmorrhage is controlled during the operation, either by applying an abdominal tourniquet, or by compressing the femoral on the brim of the pelvis, as in amputation of the thigh. The femoral artery should always be commanded, even when an abdominal tourniquet is employed, as it may slip or require to be removed from interfering with respiration. When the anterior flap is cut, the assistant grasps it so as to command the vessels completely; and on disarticulation being accomplished, another assistant compresses the surface of the posterior flap with a large sponge, raising it from time to time to allow the bleeding points to be secured. Then the femoral vessels are tied, the nerves cut short,

and the flaps approximated. Two flat compresses of lint, supported by a broad spica bandage, are applied to maintain the surfaces in apposition, and prevent blood accumulating in the stump. The greater part of the line of union is left uncovered, and one suture left untied to allow any blood to escape, so that attention may be at once directed to any excess of oozing which may take place on reaction.

The space already occupied by the subject of amputation forbids me entering on that of ARTIFICIAL LIMBS, which I felt very much tempted to do had my limits permitted. The form and usefulness of many well-formed stumps are marred by badly-fitted artificial substitutes—wonderful pieces of mechanism sometimes, but not serviceable for the purposes for which they are wanted. I allude especially to those intended as substitutes after removal of the thigh. The mechanists in general seem slow in taking the trouble to understand the difference of adaptation required in an artificial limb for a stump, the end of which is intended to support directly a considerable part of the weight of the body, and one in which the position of the cicatrix unfits it for bearing pressure, and so all are arranged on the old system for the latter class, and the advantages of a long thigh-stump, obtained by the anterior flap method, are in a great measure lost. The simplest and best artificial limb adapted for a special purpose is one described by Mr. Pollock, as suited for stumps formed by amputation at the knee-joint, and constructed by Mr. Blaise. I have only seen photographs of it, for which I am indebted to the politeness of Mr. Pollock ; but judging from these, it seems at once simple and perfect for the purpose, and I should think very little difficulty would be found in adapting it to suit the long thigh-stump formed by the method of amputation I have recommended, or that formed by the methods of Teale and Carden. In regard to artificial limbs for the upper extremity, they may be made ornamental, and, to some extent, even useful ; but no one will be Utopian enough to expect that any mechanical adaptation will form a substitute for the hand.

CLINICAL CASES

ILLUSTRATING THE SUBJECT OF AMPUTATION.

SUCCESSFUL CASE OF PRIMARY AMPUTATION AT THE HIP-JOINT.

ON the 3d of September 1863, Robert Davidson, a young lad, was thrown from a truck which had been suddenly set in motion, and fell in front of it, both wheels passing obliquely over the upper part of the left thigh just below the pelvis. The accident happened at the Melrose station, and the boy was seen almost immediately by Dr. Clarkson, who adjusted the limb, and had him conveyed to his home at Newstead, about a mile distant. About two hours afterwards, Drs. Brown and Smith accompanied Dr. Clarkson to see the case. The boy had recovered in a great measure from the shock, but his pulse was still very weak. On examination, there was found a large contused flesh wound at the upper and inner part of the left thigh, exposing the muscles, which were much torn and bruised, and allowing the finger to be passed deeply into the tissues of the limb. The femur at and below the trochanters was felt to be much shattered. The foot was cold, and pulsation in the popliteal and tibial arteries extremely weak, but there had been no great amount of blood lost.

As it appeared to the medical attendants that the boy's only chance of life was removal of the limb by amputation at the hip-joint, I was telegraphed for, and arrived at the patient's house about 9 P.M. On examination of the injury, the contused and lacerated state of the soft parts, the shattered condition of the femur, and the consideration of the great force by which the injury had been caused, left no doubt as to the practice to be pursued. I at once coincided in the opinion which his medical attendants had expressed, although, from the depressed state of the young patient, and the proximity of the injury to the trunk, the chances of success seemed very small.

The boy's parents having given their consent, I proceeded to perform the operation under circumstances not the most favourable. The room was small, and the only light procurable was from a small lamp on the mantelpiece, and two small candles held by a non-professional assistant; a wax taper I had brought with me was kept in reserve for exigencies. I had brought the abdominal compressor, but as it could not be applied so as to command thoroughly the circulation, Dr. Smith took charge of compressing the common femoral on the brim of the pelvis, and I instructed one of the patient's friends how to command the bleeding from the posterior flap, by grasping it with one hand and pressing a large sponge upon its surface. Dr. Brown took charge of the movements of the limb, whilst Dr. Clarkson administered the chloroform. When the boy was brought under its influence, I entered my knife between the trochanter major and the anterior superior spine of the ilium, and carrying it obliquely across the thigh, brought the point out a little above the tuberosity of the ischium, cutting a short anterior flap. Dr. Brown then rotated and depressed the limb, with the view of facilitating disarticulation; but owing to the shattered state of the femur, this movement did

not produce the desired effect. Fortunately, however, this caused no great delay, for my knife had opened the joint in passing across the limb ; and by grasping the upper broken fragment of the bone, so as to project the head, I completed the disarticulation, and cut as large a posterior flap as I could obtain from the uninjured parts. Some vessels on the posterior flap were first secured, and then the great vessels in the anterior flap,—the vein being included in a ligature. I then removed some contused and doubtful-looking portions of muscle. After all bleeding had been arrested, the flaps were brought together with sutures ; and considering the nature of the parts from which the flaps were formed, they fitted tolerably well. The stump was then dressed, and the patient placed in bed, hot bottles applied, and some stimulus given, as he was very weak. He lost very little blood during the operation, as I ascertained by carefully collecting the blood from the stone floor, when it was found to amount to less than half a small teacupful ; and altogether, with what was in the sponges, to about five ounces at most. After waiting till the little patient had completely rallied from the chloroform, and had got an opiate administered, I left him in the charge of Dr. Smith, who remained with him all night, and to whom I am indebted for the following report of the progress of the case :—

Examination of Limb after Removal.—On examination of the limb after removal, the femur, from the large trochanter downwards for about two inches, was found to be broken into numerous fragments, the ragged edges of which were embedded in the surrounding soft parts. The muscles and other structures were much bruised and torn, but there was no direct injury to the large vessels or nerves.

Progress of Case.—*4th September.* During the night patient was very restless and delirious. Pulse 134, weak. A little brandy and water was administered at intervals, but was vomited. No reactionary hæmorrhage of any consequence. *Vespere.*—Still restless, with delirium. Pulse 130. To have opiate with a few drops tinc. mur. ferr.

5th. Restless night. Pulse 130, very weak and thready. Sunken aspect of countenance. Beef-tea, brandy, and milk given in small quantities frequently.

6th. Rather better. Slept a little. Less delirium. Pulse 108, stronger. Wound has healthy appearance, except at the bruised part of the flap, which looks sloughy.

7th. Pulse 108. Sloughing action extending slightly on posterior flap. Fætid sero-purulent discharge. Chloride of soda lotion. Opiate.

8th. Pulse 90. No delirium. Line of demarcation formed, showing slough, rather exceeding a square inch in extent. Purulent discharge copious and less fætid.

9th. All the stitches removed, and the flaps brought together as well as possible by strips of plaster. Pulse 100.

12th. Sloughs separated. An attack of diarrhœa. Slight delirium. Opiate.

14th. Pulse 108. Diarrhœa less. Stump looking healthy. Diet for the most part milk, beef-tea, wine, with a little brandy.

16th. Doing well.

20th. Pulse has risen to 120. Had a restless night with delirium

Raw surface of stump covered with patches of whitish semi-translucent membrane of pretty tough consistence. Copious purulent discharge. Stimulants given in increased quantity.*

21st. Pulse 120. Occasional delirium. Wound has same appearance

23d. Pulse 118. Wound has less of its diphtheritic-looking covering.

27th. Stump looks healthy, and is cicatrising round the edges. Dressed with sulphate of zinc lotion. Pulse still high, 116. Sleeps well. Appetite indifferent.

1st October. Pulse 110. Doing well.

4th. Pulse 102.

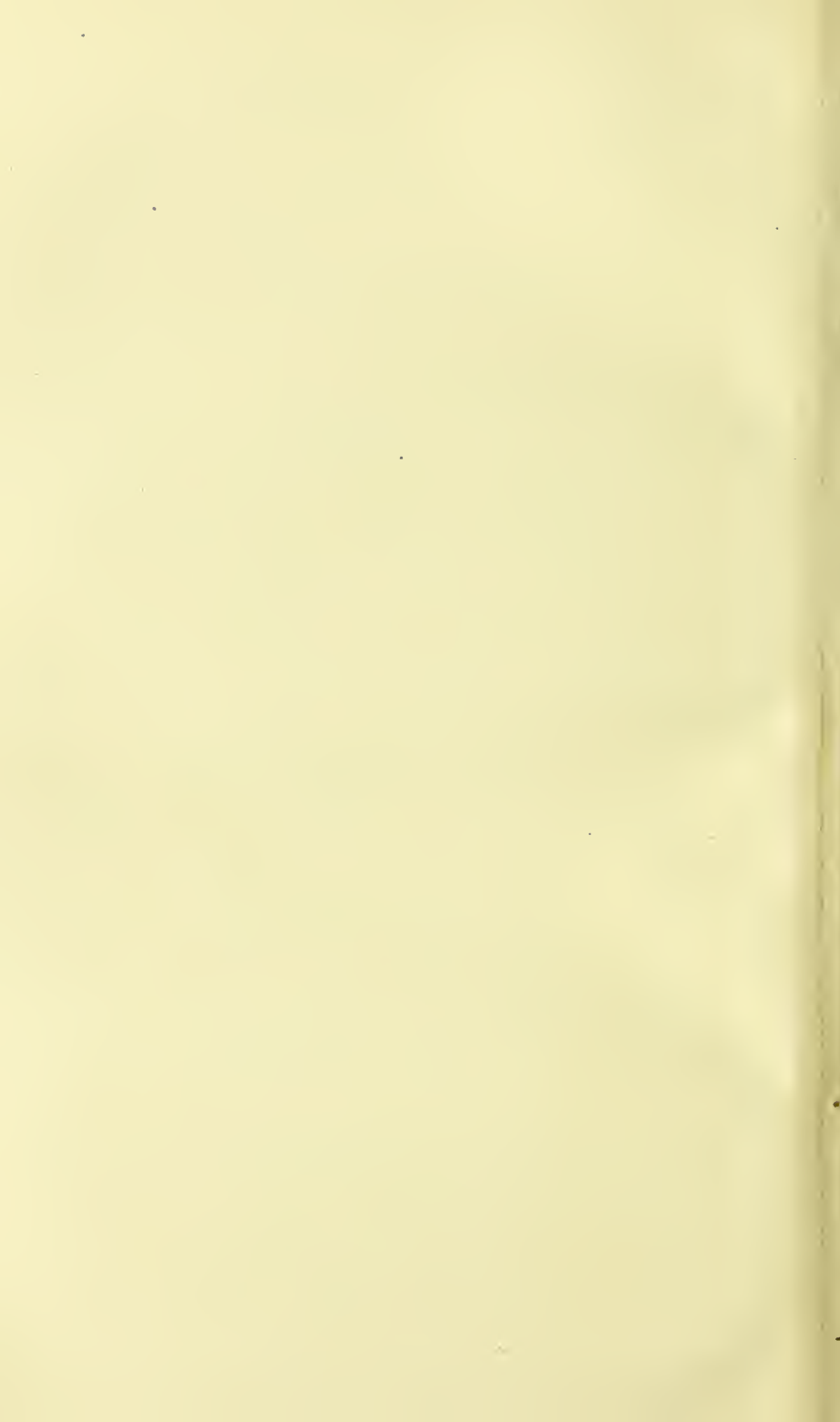
From this time recovery was slow but uninterrupted. The patient gained strength gradually, with the aid of tonics, wine, etc. The femoral ligature did not fall off till 4th November, two months after the operation, having evidently been retained for some time after its separation from the vessel by the granulations surrounding it. By the middle of December the stump was healed, with the exception of a mere spot. Two or three weeks later this also had closed, and the patient was able to move about with the aid of crutches.

Remarks.—I have thought this case would be interesting because successful results in cases of amputation at the hip-joint are rare, and in primary amputations exceedingly so. In the last edition of Cooper's *Surgical Dictionary*, it is stated that there have been six cases of primary amputation at the hip performed in Great Britain since 1838, and all of them proved fatal. In the Crimea fourteen amputations at the hip-joint were performed by British surgeons for injury, and not one recovered; and in the Punjaub in 1848-49, three cases occurred, with the same unfavourable result. And, so far as I am aware, the case I have just detailed is the first successful primary amputation at the hip-joint in Scotland. But the principal interest which such a case possesses, seems to me to be the consideration of those circumstances or conditions which may have conduced to the successful result, and which may influence our practice in similar cases.

The age of the patient may seem to explain the favourable result. It has been said that in young patients, from the greater remedial powers of nature, and the smaller surface exposed by the operation in them, the operation is likely to be more successful; but this is very questionable. The remedial

* Dr. Brown informs me that diphtheria was prevailing in the district at the time.





powers in young persons are no doubt great, when once a certain point has been passed ; but the first effects of shock, either from accident or operation, and especially the loss of blood, are not well borne by such patients, and these, together with the irritability of constitution, which is often marked, in a great measure, I think, counterbalance the remedial powers observed in them. Then, as to the less amount of cut surface, though less absolutely, it is quite as great comparatively to the size and vital powers of the patient. The amount of mutilation, the consequent derangement of the circulation, and all the risks depending on these conditions, are at least as great relatively in the lad as in the adult. From what I have observed in the case of primary amputations in young children, the patients sometimes sink rapidly and without any apparent cause, whilst even the successful cases are often attended at first with as urgent constitutional disturbance as in adults. Indeed, the state of the patient whose case I have recorded, shows how great was the constitutional shock during the first four days, and how slowly full reaction set in. The true causes of success will, I think, be found in the nature of the injury, the small amount of blood lost, and the comparatively little shock he was subjected to after the occurrence of the accident.

1st, As to the character of the injury. Although so excessively severe as to necessitate amputation, and though in dangerous proximity to the trunk, the destructive force was limited to the parts over which the wheels had passed,—there was no laceration of the limb below, nor of the abdominal region above, and there was little bleeding from the contused wound. Then the boy was seen immediately, the limb adjusted, and he was conveyed at once to his own home, so that he scarcely suffered any secondary shock from removal. Now, let me contrast these conditions with those of another case occurring in my hospital practice, and some of the causes which greatly determine the results will be pretty apparent. A man was admitted under my care in consequence of an injury inflicted by the explosion of a large iron flask containing gunpowder. The flask, the metal of

which was about a quarter of an inch thick, had been in close contact with his body when it exploded, and the wound was therefore similar to that caused by the bursting of a shell. The thigh was almost separated from the trunk at the upper and inner part. The pectinæus, adductors, and the hamstring muscles, at their origins from the tuber ischii, were divided and torn into shreds, whilst the front of the abdomen and lower part of the thorax were severely scorched by the explosion. The femoral artery, largely exposed, had escaped injury, but the vein seemed twisted and injured, as the blood was coagulated in it. There had been considerable bleeding from the arterial branches divided, and slow oozing into the textures of the limb was going on when the patient was brought into the hospital. The accident had occurred in Lanarkshire, and the patient had to be conveyed partly by road, and then by railway to Edinburgh. In this case also, the only chance of life and relief from suffering was removal of the limb at the hip ; but after rallying during the first twenty-four hours, he died on the third day. Here, in contrast to the case of the boy, we see the disadvantages of a long and tedious journey, and renewal of shock from time to time, from the unavoidable movements in being so conveyed to town ; the slow loss of blood from oozing into the tissues of the limb ; the extent and severity of the wound, and the scorching of the abdomen and chest, an injury very dangerous in itself ;—such circumstances are sufficient, I think, to explain the fatal result,—and from what I have observed in cases of primary amputations, these are conditions which, according as they are present in greater or less degree, most materially influence the success of such operations.

Perhaps it may seem that I do not sufficiently appreciate the importance of the patient enjoying the benefits of pure country air, instead of that of a hospital ward. But whilst it is perfectly true that there is much need of doing all we can to improve the ventilation of our hospitals, the dwellings of the working-classes in the country are not always or even generally models of ventilation. In the case of the boy, the room he oc-

cupied was a small closet, low in the ceiling, just large enough to contain a small fixed bedstead, leaving barely room to pass between the bed and the wall,—its only means of ventilation a small window and the door opening into the common room of the family, which also contained beds, so that whatever the purity of air in the country round, he did not enjoy much of it. Without denying the bad effects of vitiated air in hospital wards, and the necessity of doing all we can to remove that cause of mischief, I cannot help saying that a good deal of nonsense is spoken and written about the dangers of operations in hospitals as compared with those in private practice, as if all depended on hospital air alone. From some of the discussions on the subject by correspondents in the weekly medical journals, and from recent proposed methods of ascertaining the results of surgical operations in hospitals, it would almost seem as if some statisticians had so crammed their brains with mere figures as to have no room left for a single idea, or even so small a glimmering of common sense as to make allowance for the nature and class of cases admitted into great hospitals, or to pay the least attention to the circumstances under which the patients are when admitted.

As to the operation itself, the difficulties were only such as must always more or less present themselves in operating in cases of injury, where the lacerated textures prevent us from obtaining regular flaps, and where the comminution of the bone deprives the operator of the power of leverage to facilitate disarticulation. There was, however, comparatively little difficulty here, although the fragment I had to grasp was small, because I had taken care to pass the knife deeply so as to open the front of the joint in cutting the anterior flap, and by doing so the difficulty of disarticulating was much diminished. There was however, a condition present which I have seen cause serious difficulty in amputation of the thigh for compound comminuted fractures when transfixion was attempted, I mean the dragging up of the lower part of the femur, by the hamstring and adductor muscles, and the projection of the trochanteric or upper part

by the psoas and iliacus flexing it on the pelvis, so as to project it towards the skin, and prevent the knife being carried down in cutting outwards. In this case it was of no consequence, because the soft parts in front were so injured that I could not get a long anterior flap ; but, supposing the tissues to have been sufficiently sound, the bone was so tilted forward that I could not have carried the knife onwards. In such cases I would strongly recommend cutting the flap of integument and fascia from without, and then transfixing across the joint, or to cut the flap altogether from without inwards as is now generally done in primary amputations of the limbs. In regard to the vessels, it will be observed that in this, as in a former successful case of hip-joint amputation for disease, I put a ligature on the femoral vein as well as on the artery. In my former case I did so with great dread of the result, but I have since done it in some cases of amputation, and as they all did well, I am sometimes inclined to think that, instead of being hurtful, as I used to dread, it may possibly be useful as preventing imbibition or absorption of purulent or sanious matter from a large wounded surface ; but I confess I have still so much of lingering prejudice that I do not like to try or urge the practice generally. I have, however, no hesitation now in applying a ligature when venous bleeding is troublesome after amputation.

AMPUTATION AT THE HIP-JOINT.

L. S. was admitted into the Royal Infirmary on the 13th of July 1862, on account of a large tumour occupying the middle and lower parts of the right thigh. The previous history of the case is contained in the subjoined extract of a letter from Dr. Meikle :—" I attended Miss L. S. and two of her sisters, in September 1861, during a mild attack of fever. She rapidly recovered, and did not again come under my observation till April last, when I was requested to examine her right thigh. The lower third of the femur was considerably enlarged, and the soft parts surrounding it were firm, and closely matted together. The circumference of the affected portion of bone seemed bulged out in all directions, and enlarged veins were seen ramifying on the surface of the tumour. The condyles of the femur were not involved in the disease, and the portion of the shaft above the tumour was of normal size. I was told that Miss S. had felt more or less uneasiness in the part since the date of the febrile

attack ; but she could trace it to no cause, having sustained no accident. The pain at this time was very moderate, being more, indeed, a sense of uneasiness than anything else, but it was increased during the night. Measurements were taken from time to time, which showed that the tumour at first was increasing in size, but not quickly, until July last, when, after exposure to cold in an open conveyance, she was seized with pleuritis, which reduced her strength very much. From this date the tumour made rapid progress, and it became evident that nothing but amputation would save the girl, for which purpose she was put under your charge. When I first saw her, her face had a somewhat dingy appearance, and it gradually became darker, until it assumed a leaden hue."

Symptoms on Admission. Patient is pale, emaciated, and presents a very cachectic appearance ; pulse rapid and irritable ; chest and urine found normal on examination ; no glandular enlargement ; tongue slightly furred. The whole circumference of the middle and lower part of the right thigh is occupied by a large tumour, over which the veins are greatly distended. The surface of the tumour is irregular, and there is at points an indistinct feeling of fluctuation. There is no œdema of the leg, nor glandular enlargement in the groin.

15th July. To-day Mr. Spence performed amputation at the hip-joint in the following manner :—The patient having been put under chloroform, Lister's tourniquet was applied to the abdominal aorta. The breech was brought well over the edge of the table, and the pelvis held steady by an assistant. The tourniquet was intrusted to Dr. Gillespie, while Dr. Watson compressed the femoral artery at the brim of the pelvis. Mr. Spence having abducted, and slightly flexed the limb on the pelvis, gave it in charge to Dr. Struthers. Then grasping the soft parts with his left hand, Mr. Spence entered the point of the knife in front of the tuberosity of the ischium, and passing it obliquely upwards, in front of the articulation, brought out the blade almost midway between the anterior superior spine of the ilium and trochanter major, so as to form a large anterior flap, disarticulated the limb, and terminated by cutting a posterior flap nearly equal in size to the anterior. A large sponge was immediately applied to the posterior flap, until the large vessels in the anterior flap were secured. No artery jetted so long as the tourniquet was retained. After the arteries had been tied, and the tourniquet removed, the femoral vein continuing to bleed, a ligature was placed upon it. The flaps were then stitched together, and a pad placed on the anterior and posterior surfaces to keep them in apposition. The patient having been removed to bed, a beef-tea and brandy enema was immediately administered, and after she had rallied an opiate was given.

16th July. Slept well ; pulse 130 ; no reactionary hæmorrhage since the operation.

17th. Pulse 128 ; patient progressing favourably.

18th. Pulse 120.

19th. Pulse 116 ; some of the stitches removed, and straps of plaster applied ; has been taking beef-tea, wine, milk, and a little brandy for diet.

20th. Pulse 106 ; stump looking well ; no dressing on the wound except a narrow strip of lint along the line of incision, and a pillow to support the hip.

21st. Pulse 116 ; wound dressed with chloride-of-soda lotion.

22d. Pulse 110 ; some more stitches removed to-day.

23d. Pulse 106 ; the remaining stitches were removed, and straps applied.

24th. Pulse 98 ; patient is taking tincture of the muriate of iron, nourishing diet, and wine.

25th. Pulse 102.

26th. Pulse 100 ; two ligatures came away to-day.

28th. Stump looking well ; appetite good ; general appearance of patient very much improved.

29th. Pulse 100 ; tongue cleaning.

30th. Pulse 100.

31st. Pulse 96.

1st August. Pulse 90.

2d. Pulse 86.

3d. Pulse 90.

12th. Pulse 86 ; femoral ligature came away to-day ; stump almost entirely healed up.

13th September. Since last report, recovery has gone on in a most favourable manner. Not an occurrence worthy of notice has interrupted the convalescence, and to-day she returned to the country in a state of health bordering on that of former years. During the last fortnight she has been walking about the ward, and has been out several times for a drive.

Remarks.—The mortality which attends amputation at the hip-joint, and which has even led some to question the justifiableness of the operation, is undoubtedly very great ; and hence considerable interest attaches to every successful case, the circumstances under which it was performed, and all the conditions which may have a bearing upon the general question of the operation in similar cases. According to the latest statistics of the operation, given in the recent edition of Cooper's *Surgical Dictionary*, we find that, in a total of 139 cases, there were 91 fatal results, or a mortality of 65·46. Moreover, when we know that in several of the successful cases the operation was performed on limbs which had previously undergone partial amputation, and where consequently the shock and disturbance of the system caused by the sudden removal of the whole lower extremity were wanting, or at least greatly diminished, it seems evident that the risks of this formidable operation are such as must limit its performance to cases of extreme necessity.

In cases of certain severe injuries the surgeon may be forced

to perform it as the only chance of saving, or, at least, prolonging life, and alleviating suffering, by removing the shattered limb. In cases of disease, the question of operation comes before us under a somewhat different aspect, for the amputation may prove more speedily fatal than the disease would have done if left to its own course. Hence, to warrant its performance, the disease must be of a kind that admits no other remedy, and at a stage when the whole of the appreciable disease can be removed, and with a reasonable hope of prolonging life. In the case which forms the subject of the present remarks, we have a good example of the conditions which warrant us in having recourse to amputation at the hip-joint. The girl was suffering from intense pain, her appetite was almost gone, and her strength exhausted by the pain and want of sleep; her pulse was quick and irritable, whilst the tumour was increasing rapidly. The urgency of these symptoms showed the necessity of operative interference, if any attempt was to be made to relieve her sufferings and to prolong life, even for a short time; whilst the absence of glandular enlargement, either in the groin or elsewhere, gave hopes that the lymphatic system was as yet unaffected, and that, with youth on her side, there was a reasonable hope of success attending the operation. On the other hand, if it were delayed, or not performed, a speedy and painful death was certain.

The disease was limited as far as malignant disease can be said to be limited in the living body, where the circulation of the fluids prevents positive limitation to any special part. But, practically, surgeons are agreed, from experience, that malignant disease, especially its medullary form, when situated in an anatomically limited organ—as the testicle, for example, where it is invested by a dense resisting capsule—admits of more thorough removal than when it occurs amongst muscles or other soft textures, whose structure it speedily involves in the same diseased action, without any definition or limitation. In the present case the disease had evidently commenced in the interior of, and was still apparently confined to, the shaft of the femur. Thus walled in, as it were, by the dense fibrous shell of the bone, or by the

strong fibrous periosteum investing the shaft on every side, and closed in at either extremity of the bone by the articular cartilage of incrustation, the disease presented the utmost possible degree of anatomical limitation, and thus the best possible chance of complete removal. But to profit fully by this limitation of the disease, it was evidently necessary to amputate in the contiguity, and not through the continuity of the affected bone—a rule which I consider of paramount importance in such cases. Hence the reason why I considered amputation through the trochanters inadmissible, although the bone seemed unaffected; for, in many cases where no perceptible alteration in the form of the bone can be detected, the disease will be found to be infiltrated into the cancellated texture, even of the neck and head of the bone; and there need be the less hesitation on this point, as I believe that, in cases of malignant tumours of the femur, amputation through the trochanters is attended with quite as much danger to life as amputation at the hip-joint.

I would here refer to the necessity which arose for applying a ligature to the femoral vein. The hæmorrhage from this vein continued after all pressure had been removed from the groin and abdomen, and as temporary pressure of its orifice, and other means, failed to arrest it, and as it returned whenever the pressure was removed, I found it absolutely necessary to tie it. I have frequently seen troublesome bleeding from the femoral vein in amputation of the thigh, but in general it stops when compression is made by applying the flap against the cut surface, when all pressure above is removed, and the stump elevated; but here these means proved ineffectual, or, perhaps, I should rather say the weak condition of the patient rendered it necessary at once to check all loss of blood. I confess that my prejudices against tying veins are very strong, and this step in the operation made me uneasy as to its effects; but, as the history of the progress of the case shows, my fears were groundless, not a single bad symptom having followed ligature of the vein.

In conclusion, the uninterrupted progress of the patient's recovery was most satisfactory. It is not often that even a

simple amputation of the thigh goes on so well; and whatever may be the estimate of the operation in general, or whatever may be the chances of the disease returning in some other organ hereafter, it has, for the present at least, snatched the patient from the brink of the grave and restored her to her family, and to the enjoyment of perfect health.

AMPUTATION AT THE HIP-JOINT.

M. W., aged 5 years, was admitted on May 29, 1865, into the Royal Infirmary, suffering from a tumour of the right thigh.

History.—Patient's mother states, that about six months previous to admission the child complained occasionally of wandering pains in the right thigh, for which fomentations were applied. About three months previous to admission, however, the mother observed the patient walking as if her right knee was stiff; she had a considerable amount of pain in the limb; was sometimes fretful and low-spirited, but her general health was good. On being asked where she had pain, the patient referred it to various parts of the thigh; and on examining locally, the mother observed an oval lump on the outside of the lower part of the thigh, about the size of a "blackbird's egg," and said to be deeply seated. No increase of growth was observed, however, till about ten weeks before admission, when the child is said to have received a blow on the lower part of the thigh (with a chair), and since that time the tumour has been increasing rapidly. Since then, the patient has also complained greatly of pains in the limb, on account of which the part has been fomented, poulticed, and leeches, without any relief. The parents then consulted Dr. Thomson of Yetholm, who, recognising the nature of the case, prevailed upon them to send her to the Infirmary. During the last few days, the patient has been losing her appetite, is low-spirited, and complains more of pains.

On admission into hospital.—Patient appears to be healthy, but is unusually quiet and reserved. Tongue slightly furred; lungs, heart, and other organs, normal. A tumour, of oval form, $5\frac{1}{2}$ inches in length, and about the same in breadth, was found occupying the anterior, outer, and posterior surfaces of the middle and lower part of the femur, just above the condyles. It is of firm consistence throughout, and moves along with the femur. The superficial veins are enlarged, but the skin is not adherent. Patient does not complain of pain on pressing the tumour. The inguinal glands on both sides, as also the right cervical glands, are hard, and somewhat enlarged.

1st June.—P. 86. Sleeps well, and is much better in health. Ordered alterative medicine, followed by tincture of the muriate of iron and cod-liver oil, twice daily.

6th.—P. 96. Has had more darting pains in the limb. General health continues good. Tumour not perceptibly larger since admission of patient into hospital.

7th.—P. 80. Slept well. Chloroform having been administered,

Professor Spence made an exploratory incision into the swelling, and discovered it to be a tumour, as diagnosed. The patient's pelvis was then brought well over the edge of the table, and held firmly by an assistant. Professor Spence next, grasping the soft parts with his left hand, entered the point of the knife at the front of the ischial tuberosity, and passing it obliquely upwards in front of the articulation, brought it out almost midway between the anterior superior iliac spine and the trochanter major, so as to form a large anterior flap. Having opened the joint by this first incision, while Dr. Gillespie abducted the limb, the disarticulation was effected, and a posterior flap nearly equal in size to the anterior one was cut from within outwards. Immediately thereafter, a sponge was applied over the posterior flap; Dr. Watson compressed the vessels over the brim of the pelvis. The vessels, including the femoral vein, were then ligatured, the flaps stitched together, pads placed over the anterior and posterior surfaces, and bandaged. When the effects of the chloroform had passed off, an opiate was given, but the patient continued very restless, requiring to be held down for some time. No reactionary hæmorrhage took place.

On examining the limb, the tumour was found to be of a greyish colour, of firm consistence, and of a medullary character. Microscopic examination of the adductor muscles of the thigh showed the nuclei of the muscular fibres to be greatly increased in number, and seemingly about to undergo cancerous degeneration. The fibres of the gluteus muscle showed fatty degeneration, but no proliferous cells.

6.30 P.M.—P. 80. Patient has been sleeping continuously for some hours, is very thirsty and restless at intervals, and vomits on trying to take food.

9 P.M.—P. 100. Urine drawn off with a catheter. Opiate given as vomiting continued.

8th.—P. 100. Spent a very good night. Urine drawn off with a catheter.

4.30 P.M.—Patient has been sinking gradually, and is now unconscious. Pulse, not perceptible; respiration, rapid and very weak; has slight bronchitis; eyelids partially closed, and eyes oscillating. Ordered Spt. ammon. arom. in five drop doses, every five minutes; also an enema of beef-tea and wine, and a mustard-poultice to the chest.

6.30 P.M.—Still continues in a very weak state. P. 156, and very weak; respirations, 60 per minute; has had her bowels opened freely. Beef-tea injections given every hour, and sal-volatile at intervals.

11 P.M.—Under this treatment patient rallied gradually; but as the nervous symptoms continued, fifteen drops of sol. mur. morph. were added to the beef-tea injections. P. 140; respirations, 40 per minute and regular; has grinding of the teeth, twitchings of the face, with knitting of the brows, and gives occasional starting and delirious exclamations.

1.30 P.M.—P. 150, weak. Cerebral symptoms and general weakness somewhat increased.

9th, 10 A.M.—Has slept well during the night, and cerebral symptoms are absent. P. 140, weak; takes no food, and is supported by enemata; respiration regular and not laboured.

4 P.M.—Continues in much the same condition; has occasional grinding of the teeth and startings of the limbs. P. 112. Supported by enemata.

10 P.M.—P. 130, and weak. Same treatment continued.

12.30.—P. 140, and weak. Consciousness returned and patient is inclined to sleep; cough somewhat increased, and pain in the abdomen complained of. Ordered a large poultice over the chest and abdomen; takes some food.

10th, 4 A.M.—P. 120. Has been sleeping calmly, but is beginning to start somewhat, and grinds her teeth slightly.

8 A.M.—P. 104. Very weak; is unconscious; grinds her teeth; lies with her eyes wide open, and complains of great tenderness in abdomen. Enemata continued, and poultices on abdomen.

10 A.M.—P. 116. Drinks milk heartily; stump dressed and looking healthy.

12 M.—P. 120. Weak; some of the old symptoms returned. Enema given. From this time forward, patient gradually recovered. None of the cerebral symptoms returned, and appetite gradually improved.

11th.—P. 100. Is in good spirits; slight erythema along the edge of the wound. Some stitches removed. Discharge somewhat increased.

12th.—P. 108.—Patient continues to do well. This morning she took a hearty breakfast of porridge and milk, in addition to tea, toast, and eggs. The stump looks very well; there is not much discharge, and it is of a healthy character. As the cough is troublesome she is ordered to-day the following mixture:—℞ Ammon. sesquicarb. grs. xxiv.; tinc. scillae, ʒii.; decocti Senegae, ad ʒvi.; sig. a teaspoonful every three hours.

13th.—P. 104, of good strength. During the night she slept well, but was observed to start occasionally. Plasters applied to stump and stitches removed. Dressed with soda lotion.

15th.—P. 90; bowels regular; appetite good.

17th.—All the the ligatures except one have separated. General health continues to improve. At the inner angle of the stump is a hard, red, and painful swelling, evidently an abscess commencing to form; for this fomentations were applied. P. 110.

21st.—P. varied from 104 to 120 during the night. Stump looking very well. Sleeps soundly. Appetite good.

23d.—P. 104. Yesterday, passed four, and to-day eighteen ascarides lumbricoides, of which some were very large. Ordered a purgative, followed by ℞ Santonin, gr. viii.; sacchar. ʒi.; M., et divide in pulv. iv.; Sig. one to be taken night and morning.

25th.—Passed two more worms of the same kind, but smaller. Appetite has fallen off somewhat. The abscess in the groin burst to-day at the outer angle of the stump.

July 3d.—Since last report convalescence has been uninterrupted. To-day passed another small worm, which was the last.

From this date onward the patient improved daily. Appetite returned by degrees. The femoral ligature was withdrawn on July 6th, and the incision healed up without the slightest bad sign, and remains quite sound at the present date.

Whilst it is generally admitted that the true principle in regard to amputation for malignant tumours of bone is to amputate be-

yond the bone affected, yet in the case of the femur, the dread of the immediate risks of amputation at the hip-joint has led practically to the abandonment of the principle, and amputation through or near the trochanters, in cases of malignant tumour, is often advised, and resorted to, as being safer than disarticulation, unless the growth is so high up as nearly to involve the trochanter. I think this a very serious error, as I believe, in such tumours, the disease permeates the whole of the medullary and cancellated texture of the femur, and that there is no security for the removal of the disease except in removal of the entire bone, by disarticulation ; and from what I have seen of high amputations in the thigh, for malignant tumours, I believe the risks of amputation through or near the trochanters to be as great, if not greater, than those of amputation at the joint. In the latter, the rapidity of performance is greater, the loss of blood less ; whilst the risks of pyæmia are certainly less in cases of disarticulation than in amputation through the continuity of a bone, where we have the chances of myelitis, inflammation of the veins of the medullary Haversian canals, and acute necrosis, which are especially liable to occur in the state of the system accompanying malignant disease.

Besides the interest which attaches to a successful case of amputation at the hip-joint, that just recorded possesses interest in regard to the diagnosis of the disease, and the condition and treatment of the patient after the operation.

The general history of the disease from its commencement ; the obscure wandering pains referred to the thigh long before any alteration in the limb was detected, and then the appearance of a small but distinct lateral swelling as described by her mother, together with the subsequent rapid growth and increased pain, were all very characteristic of malignant disease of the femur. On the other hand, however, there was not the slightest appearance of the peculiar cachectic state which so generally accompanies malignant growths ; the child was of ruddy complexion and plump, her appetite good, and all the functions natural, though she was restless and somewhat irritable at night. The

mother, however, had with her another younger child, evidently affected with strumous swelling of the periosteum, bones, and glands. At the time of the patient's admission into hospital there was no lateral projecting swelling, simply an elongated ovoid swelling, or enlargement of the femur, from the condyles to near the trochanters. Under these circumstances the question arose,—Might not these symptoms be caused by periostitis and subacute ostitis, and perhaps incipient necrosis? To my own mind, the absence of rigors or febrile symptoms at any time during the progress of the disease, the distinct lateral swelling noticed at first, and the peculiar ovoid form of the enlarged femur, seemed pretty conclusive as to its being a malignant tumour of the bone; but still, under the circumstances, before proceeding to such an extreme measure as amputation at the hip-joint, I considered it right to resort to an exploratory incision, as recorded in the report. In many instances a free exploratory incision will at once satisfy the surgeon as to the true state of matters; but here it had a tendency to mislead, for, owing to the cancerous deposit being situated partly within the medullary canal of the femur, and partly between the periosteum and the shaft of the bone, and easily separable, it resulted that when I introduced my finger into the incision, I felt the bone bare and loosely connected with swollen periosteum, just as in a case of necrosis, so that I had to enlarge the incision considerably to judge of the true state of the swelling. I draw attention to this, because unless I had been pretty well decided before as to the nature of the disease, the condition presented in this case, so different from the irregular softened mass mixed with osseous spiculæ, generally met with in malignant osseous tumours, might have led to a wrong diagnosis and most disastrous results.

The method of operating in this case was the same as that I adopted in the case of L. S., previously recorded, and I think it the best in such cases where we have the power of choosing our procedure. Amputation at the hip can be readily performed by cutting one very large anterior flap, and disarticulating and dividing the posterior parts almost directly backwards; but as

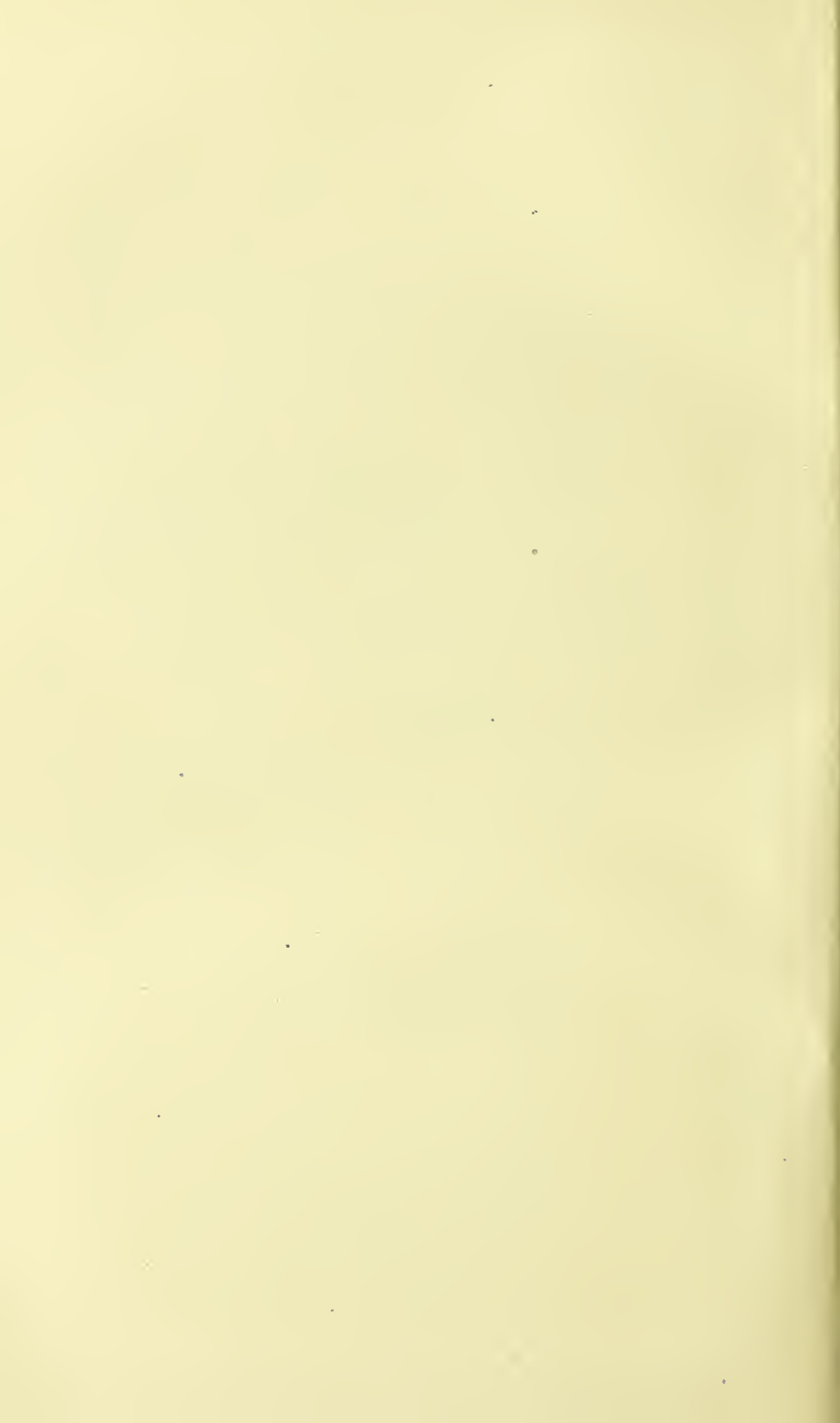
examination shows that even at an early period the muscles near the diseased bone are liable to be affected, it is of vital importance to plan our operations to avoid proximity to the tumour, so as to diminish the risk of retaining any morbid tissue in the flaps. Hence I prefer two shorter flaps to one very long one, as it must encroach more on the diseased parts by its greater length. In this, as in other successful cases I have recorded, the femoral vein was tied to arrest bleeding, and I believe, as I have stated elsewhere, that instead of being hurtful it seems rather to do good, by preventing pus or unhealthy discharge entering the venous circulation by the large open mouth of the vein, kept patent as it is by its fascial connections.

The progress of the case as given in the report shows how much success in such operations depends on careful after-treatment, watchfulness of symptoms, and persistence in appropriate remedial measures, even when the condition of the patient seems very hopeless.

It will be noticed that the urgent unfavourable symptoms in this case did not supervene till about twenty-four hours after the operation, when the risk from primary shock and reactionary hæmorrhage had passed. The morning report on the 8th June was "Pulse 100 ; spent a very good night," and at my visit at noon the child presented no unfavourable symptom ; but shortly after 3 P.M. symptoms of restlessness, nausea, and a state approaching to collapse, as detailed in the report, set in suddenly, and at 4 P.M. she seemed to be rapidly sinking. I believe that, but for her being very carefully watched, and the prompt and continued use of external and internal stimuli, the little patient must have soon died.

The character of the symptoms was peculiar : there had not been the slightest amount of reactionary oozing from the stump, and the child had slept well after the operation. Yet the state must have been the effect of the operation on the nervous system ; although it is just possible that the tenderness of the abdomen, the grinding of the teeth, and convulsive startings, may have been due to the presence of so many large intestinal worms ;





for though the more severe symptoms passed off, and she gradually began to amend, yet her rapid and thorough convalescence dated from the time the worms disappeared under the use of the santonine.

PRIMARY AND SECONDARY AMPUTATIONS FOR INJURY.

I have selected the following as examples of the class of cases requiring amputation in consequence of injury, and as illustrative of what I have said in reference to the conditions which influence the mortality of primary amputation :—

SEVERE INJURY OF THE RIGHT UPPER EXTREMITY BY MACHINERY ; AMPUTATION OF THE SHOULDER-JOINT ; RECOVERY.

CASE I.—On the morning of the 9th December 1847, James Watt, millwright at a large paper-mill in the vicinity of Edinburgh, when inspecting the machinery, perceived that a part of it was loose. While engaged in fastening the loose part, the sleeve of his jacket was caught, and the right arm dragged between two wheels, and rapidly crushed. Notwithstanding the fearful nature of the accident, he possessed sufficient presence of mind, on feeling himself drawn forwards, to take off his cap with his left hand, and place it in a position to check in some measure the revolution of the wheels, and at the same time he directed those about him to cut the sleeve of his coat, telling them that the arm was already torn through. He was extricated just in time to prevent the body being drawn in, but not before the soft parts on the right side of the chest had suffered severely. The accident happened about half-past four A.M., and I saw him at half-past seven A.M.

I found Mr. Falconer and Dr. Thomson in attendance. The patient was lying in bed, pale and exhausted, having lost a considerable quantity of blood ; but, though suffering great agony, he was quite sensible ; the fragments of his clothes which had been left by the machinery had been removed, some stimuli had been administered, and external warmth applied ; his pulse was about 120, and the skin was covered with cold sweat. The injured arm presented a frightful appearance ; the limb was completely detached from about three inches above the elbow, and the humerus was again broken through obliquely immediately below the insertion of the deltoid, leaving the attachment of that muscle entire ; but on the inner side, the fracture had splintered the bone up to within an inch of the joint ; the middle part of the humerus, together with the soft parts, were hanging in shreds. On the right side of the chest, the integuments had been entirely removed to within two inches of the sternum ; the clavicular and sternal portions of the pectoralis major had been completely torn off, so as to expose the pectoralis minor, the intercostal

spaces, and externally the fascia covering the axillary vessels and nerves. The fragment of the humerus was drawn upwards and outwards by the deltoid, and the lower fibres of the great pectoral which were entire, were tightly stretched across the lower border of the large wound, and gave it the appearance of a deep dissection. Although, from the nature of the injury, and the state of the patient, I had almost no hopes of his recovery, I thought it right to give him the only chance—viz. by amputation at the shoulder-joint.

A small quantity of spirits and water having been given, chloroform was then administered. About a drachm was poured upon some lint and applied to his nostrils by Dr. Thomson. He inhaled it readily, and scarcely a minute had elapsed ere it took effect: the fibres of the exposed muscles were first seen in violent action, and the face became suffused, the breathing became stertorous, the fibres of the muscles assumed a slight tremulous motion, and then became perfectly still; his pulse fell in frequency, but was firm; the full effect of the chloroform was obtained in three minutes.

Mr. Falconer compressing the axillary artery between his fingers, above the lesser pectoral, I proceeded to amputate by forming my flap from the outer and back part of the shoulder, where the integument and muscles appeared sound, saving as much skin as possible. From the short lever remaining, I had anticipated considerable difficulty in disarticulating the head of the humerus; but in this I was agreeably disappointed, for, owing to the complete relaxation of the muscles induced by the chloroform, I was enabled to disarticulate it rapidly and with the most perfect ease. The insertion of the lower fibres of the great pectoral, and the other soft parts on the inner side of the humerus were divided, and the fragment of the limb removed. The posterior circumflex and two other vessels were tied, and next the axillary at the point where my incision had divided it: perceiving, however, that this point was close to the origin of some large branches, and fearing, moreover, lest it might have suffered from the injury, I laid bare the vessel higher up, beneath the lower margin of the pectoralis minor, and tied it there also; after removing carefully all doubtful-looking portions of muscle and skin, the flap was brought forward and found to cover the wound much better than I expected; it was secured by several points of suture, supported by compresses placed posteriorly at the lower part to prevent dragging, some warm-water dressing was placed over the surface anteriorly, and the whole secured by a split cloth bandage.

During the whole of the proceedings, which occupied about a quarter of an hour, the patient remained perfectly tranquil, and only became conscious after the dressing had been completed; a little wine and water were then given. He stated that he had felt no pain, and indeed knew nothing of the operation, but now felt much easier and revived; his pulse was at this time 68, and pretty firm. I left him in charge of Mr. Falconer, desiring that he should have an opiate draught. According to Mr. Falconer's report, the pulse gradually rose, and at three P.M. was 84 in the minute. There was considerable thirst, and he complained of darting pain in the wound, also of slight nausea, which, however, soon left him. In the evening he was less thirsty; the pulse continued the same, and he

passed about six ounces of urine. Had a draught of thirty drops of solution of morphia at midnight.

At four A.M. on the 10th his pulse was slightly accelerated and harder; he had slumbered occasionally for about half-an-hour at a time, but woke with pain in the wound; the skin was warm and moist, and after he had passed about six ounces of high-coloured urine, he fell asleep, and rested for some time; at noon he had a laxative draught.

On the morning of the 11th he continued pretty easy, having passed a good night, but as his medicine had not acted, he got a dose of castor-oil. His tongue was white and furred. Before twelve o'clock his bowels had acted twice freely, and his skin was moist, and of a natural heat; he was allowed a little beef-tea. In the afternoon his pulse had risen to 100 in the minute, and was pretty full, though soft. The beef-tea was discontinued, and a little thin arrow-root allowed instead. In the evening he had passed water freely, and felt easy, but his pulse was still about 100, and the skin hot; had no headache. To have a draught of morphia and ipecacuan wine at bed-time.

12th.—7 A.M. Has passed a good night, pulse diminished in frequency and soft, skin of a moderate heat.—3 P.M. Has suffered from sickness since morning. The wound was now dressed for the first time, and at his own request chloroform was administered; but after it began to affect him, vomiting took place, and Mr. Falconer desisted from its use. The wound was found of a favourable appearance; suppuration had commenced at the lower part; a little wine was administered previous to the dressing; he felt much easier after its completion, when an opiate draught was given.

At 10 P.M. his pulse was 92, and soft; he still felt sick, and had not slept since the dressing. To have a large opiate draught.

13th, *Monday*.—Passed a bad night; suffered greatly from sickness and vomiting; pulse 96, tongue covered with white fur, but red at tip and edges; half a grain of solid opium was given him. At noon the bilious vomiting and sickness still continued; pulse 100, countenance anxious. To have one grain of solid opium. At six P.M. he was much easier, the vomiting had ceased; he had taken a little thin arrow-root and drank some tea. As he had no evacuation from the bowels since Saturday, an enema was ordered, and after it had acted a grain of opium was given at 10 P.M.

On the 14th I saw him along with Mr. Falconer, and dressed the wound, which I found uniting at the upper part, and granulating at the other parts of the wound, the suppuration was of a healthy character; he bore the dressing without much fatigue; his pulse previous to the dressing was 86 and soft, the expression of his face and general appearance good. He had had no return of the nausea or vomiting, but his tongue was still somewhat furred, and he complained of thirst. For the purpose of allaying thirst and abating the irritability of the stomach, I sent him some citrated alkali for effervescing draughts.

On the 17th, one of the ligatures came away, and on the 18th another, but without the slightest tendency to bleeding: from this time he continued to go on favourably; the wound healed rapidly, and no circumstance worthy of note took place, except a slight attack of bronchitis, which was promptly and actively treated, and he was able to leave his bed

on the 1st of January 1848 for a short time, at which period a great part of the wound had cicatrised. On the 8th of January the ligature from the upper part of the axillary artery separated (this ligature had been marked at the time of the operation by a double knot on its free extremity; the ligature from the lower part of the vessel, where it had been divided in the amputation, came away on the 17th of December).

In the beginning of February the wound was completely healed, with the exception of one part about the circumference of a sixpence, where a ligature projected, this I took away some time afterwards, and then this remaining part also healed up rapidly.

Remarks.—This case affords an example of the great amount of injury from which the system may recover; and the results of this and similar cases warrant us in entertaining hope and having recourse to operative measures even in the most aggravated cases. Few examples of injury could have presented a more frightful appearance, or less likelihood of a favourable result, not so much from the shattered state of the arm and the quantity of blood he had lost, as on account of the extent of the laceration of the soft parts covering the chest, one side being almost denuded of its cutaneous and muscular coverings, and the patient lying cold, pallid, and collapsed, from the effects of the severe suffering he had undergone.

From the state in which I found him, I have little doubt that, had he been removed even a short distance to obtain surgical aid, the result would probably have been very different. Indeed, from what I have seen of primary amputations, I believe that the very different results of such amputations in civil hospitals and military practice, and the comparatively greater success which will be found in private practice over hospital cases, is owing in a great measure to the fact, that in military and private civil practice, the operation is performed either on the spot, or at a short distance only from where the accident occurred, so that the patient undergoes but one shock; whereas a majority of the cases presented to the surgeon in hospital practice, are often brought from a considerable distance, not in the easiest or most eligible conveyances,—and thus the patient, just recovering from the first effects of severe injury, is subjected to a second shock, or rather series of shocks, from the jolting of the

shattered limb, before undergoing amputation ; a condition which, in itself, apart from other considerations as regards the effects of hospital air, etc., is evidently less favourable than that of the patient to whom surgical assistance has been afforded without his having undergone a rough and exhausting journey.

There is another point to which I would direct attention, as I consider it of some importance to the prevention of secondary hæmorrhage, in cases where there is extensive injury of the soft parts around the vessels. In severe accidents from direct violence by machinery, the parts even beyond the apparent injury often suffer indirectly, their vitality is impaired above the points of amputation, and extensive suppuration or separation of small sloughs takes place around the vessels, or the vitality of the arterial tissue itself may have been so impaired by the traction and twisting, that separation of the ligature will probably take place, and secondary hæmorrhage occur, at a period before the canal of the artery has been obliterated. It was to avoid such a risk in this case, that besides tying the axillary at the point, divided by the knife in amputating, I laid it bare and tied it higher up ; and the result, I think, shows the propriety of the practice, for the lower ligature came away in eight days, so that, except for the ligature higher up, secondary bleeding would likely have occurred at that time. The case has also this interest, that it was the first great operation in which I used chloroform, which had just been proposed, instead of ether.

INJURY BY MACHINERY—DEATH FROM SECONDARY HÆMORRHAGE.

CASE II.—In October 1852 I was sent for by Dr. Ellison of Penicuik, to see a young man who had received a severe injury of the right arm by machinery in a paper mill. I found the soft parts of the arm from near the shoulder, and down the forearm, extensively lacerated, the muscles in the upper arm being fairly stripped off the humerus, a portion of the inner side, comprising the great vessels, having alone escaped. The bones were not fractured, but from the nature and extent of the injury, and the complete destruction of the muscles and skin, it was evident that amputation at the shoulder-joint was the only chance for the patient.

This I did by lateral flaps, disarticulating and then forming the inner flap by cutting outwards. Whilst I was cutting outwards through the

nerves and vessels, the patient, having partially recovered from the chloroform, made a sudden movement, which threw off the hold of the gentleman who was compressing the subclavian artery, and a gush of blood from the axillary blinded me ; but luckily I succeeded in grasping the vessels and nerves, and secured the whole mass temporarily, till I had tied the smaller vessels ; then I cleared the axillary higher up, and placed a ligature upon it, removed the temporary ligature, closed the flaps by suture, and dressed the stump.

Next day I found the patient going on favourably : there had been slight venous oozing, which was arrested by cold water cloths, and there was now neither oozing nor tension of the stump. On the fifth day the patient was going on exceedingly well ; a large part of the stump had healed by the first intention, though at the lower part, there was a considerable discharge of pus along the course of the ligatures, and a little erysipelatous redness.

Late at night, on the sixth day after the operation, I was sent for, on account of the sudden occurrence of hæmorrhage, but before I reached his house, the patient was dead.

On opening, and examining the stump, the greater part was found solidly adherent, and even along the course of the vessels, there appeared to be no great amount of sloughing or suppuration. The hæmorrhage was from the axillary, which presented an open mouth, as if cut with a knife, to the extent of about two-thirds of its circumference, the ligature being still attached to the remainder. I learned from Dr. Ellison that the patient had been exceedingly well all that day, and that Dr. E. had seen him shortly before the bleeding occurred. It came on either during, or shortly after, the patient had been turned in bed, and though Dr. E. succeeded in arresting it by pressure, so much blood had been previously lost, that he soon sank.

CASE III.—J. C. was admitted in a state of great prostration, due to a severely compound comminuted fracture of the humerus, with the limb almost severed from the trunk ; a dislocation of the right hip ; and a very severe wound of the dorsum of the foot. As the chief laceration of the tissues was on the inner surface of the arm, amputation was performed by a long antero-posterior flap cut from without. Died twelve hours after admission.

CASE IV.—John L., æt. 66. Compound comminuted fracture of the arm and forearm, the result of a railway injury. The patient had come from a distance, and had lost a large quantity of blood. Amputation by a long external, and a short internal flap cut from without. He sank next day.

Remarks.—Primary amputation at the shoulder-joint is one of the most successful of the major operations. If a fatal result speedily follows its performance, as in the two last cases, it will be found to depend on unavoidable causes, such as the complex nature of the injuries, hæmorrhage, etc. One died from the

severe shock arising from the crushed arm, the dislocated hip, and the lacerated foot; the other, an old man, perished from the effects of the loss of a large quantity of blood previous to admission.

Secondary hæmorrhage, which occurred in the amputation at the shoulder (No. II.), is by no means a common cause of death after primary amputations; but as it has led to a fatal result in other cases of amputation at the shoulder-joint, it may be as well to examine into its probable causes in the case narrated.

The artery had been tied well up from the margin of the flap, where all the tissues were apparently sound; there seemed to have been no want of healthy action in the stump, as the greater part had united, and there did not seem to have been any great amount of suppuration even along the course of the vessel; yet the bleeding occurred at a very early period, and the vessel, little altered in appearance, seemed as if cut with a sharp instrument for about three-fourths of its circumference; in short, divided by acute ulceration, presenting no appearance of internal clot or external plastic effusion.

The nature of the injury, in this case, may probably account for the result, for the arterial tissue may have suffered from the dragging and twisting by the machinery, and thus had its vitality impaired to a much greater extent than would at first sight appear. When the injury necessitating amputation is direct, as a crush by machinery or the wheel of a carriage, the arterial tissue is not likely to be affected much beyond the parts injured; but when the limb has been dragged and twisted by machinery, as in this case, then, as I have said, the effect of the traction may have injured it much higher, and hence the more rapid ulceration caused by the ligature. I suspect, also, from what I was told, that the patient, feeling pretty well, had not been so quiet as was desirable, and he was being moved when the hæmorrhage occurred.

DOUBLE PRIMARY AMPUTATION OF ARM.

T. A., æt. 25. Both hands and lower part of forearms blown off by the explosion of gun-cotton in a quarry. Though patient was very weak and only partially conscious, Professor Spence amputated both arms as being patient's only chance. Patient lived for one hour after the operation.

SECONDARY AMPUTATION OF ARM.

G. G., æt. 17. While leading a horse by the bridle the animal seized the forearm with his teeth, and inflicted a compound comminuted fracture. He was under treatment for ten days previous to being sent to hospital. Conservative measures were tried, and a fortnight after admission several pieces of bone were removed. Under the prolonged discharge from the wound, and from the ulcers which had formed over the sharp prominences of the condyles, his general health became impaired. The inflammatory action extended towards the wrist, and in the fourth week suppuration occurred within the joint. Under such circumstances, there could be no hesitation in removing the limb. The operation was performed below the middle of the arm by a long external and short internal flap formed by transfixion. Recovered.

PRIMARY AMPUTATIONS OF THE THIGH AND LEG.

1. John Reilly. Compound fracture of tibia and fibula, communicating with knee-joint, the result of a railway carriage passing over his leg. Amputated at lower third of femur. Long anterior flap. Pyæmia set in, and patient died at the end of the fourth week.

2. Alexander R——, whilst in a state of intoxication, fell under the wheels of a railway carriage, and sustained a compound comminuted fracture of both legs—in the one communicating with the knee-joint, whilst the other limb was almost completely cut off below the knee. Amputation of both limbs performed at lower third of femur. Patient never rallied, and died on the third day.

3. Jessie Brown was violently whirled round by machinery, and sustained a very severe compound fracture of thigh, together with laceration of perinæum. The limb was amputated very high up; but patient never rallied, and died on the following day.

4. R. B. Compound comminuted fracture of right leg and arm. A railway carriage had passed over the leg, crushing it to a complete pulp. This patient having lost a large quantity of blood previously, was admitted in a state of complete collapse, from which stimulants freely administered failed to rouse him. As there was oozing of blood into the tissues of the leg, amputation by the long anterior flap was performed at the lower third of the thigh, as affording the only chance of life. Had the state of the patient admitted, the arm also would have required amputation. He lived twenty-six hours after the operation.

5. P. L—— fell down a height of thirty-five feet, and was brought to hospital suffering from compound comminuted fracture of femur, commu-

nicating with knee-joint, and a similar fracture of both bones of leg. Amputation at middle of thigh. Cured.

6. J. M'C., æt. 33. Compound comminuted fracture of the leg communicating with the ankle-joint, resulting from a railway-truck having passed over the limb. Amputation below the knee by long internal, lateral, and short external flaps, cut from without inwards. There was not the slightest tendency to the projection of the margin of the tibia ; the recovery was rapid and complete.

7. C. C., æt. 73, was knocked down and run over by a loaded van. The chief injury sustained was a compound fracture of the leg, for which amputation below the knee was performed by the long posterior flap cut from without. She had been a habitual drunkard for years, and was intoxicated at the time she sustained the injury. The wound remained in a very inactive state, the discharge being thin and serous. She died on the sixteenth day after admission.

8. J. M., æt. 25. Compound comminuted fracture of leg and ankle, resulting from a railway waggon passing over the limb. Amputation by a long posterior flap. Recovered.

Commentary.—As regards the advantage of primary over secondary amputation in all cases where there is no reasonable hope of saving a useful limb, or where the risks to life seem too great to warrant any attempt to save the limb, I think there is now very little difference of opinion amongst practical surgeons ; but in these days of conservative surgery, some few looking at the admitted danger of primary amputations, such as those of the thigh, seem to think that in almost all cases we should make the attempt, or at least delay, for, say they, you may perhaps save the limb, and if not, you can always amputate later with perhaps a better chance of success. But this is assuming what is not the fact, for every surgeon who has had much experience in accidents, knows, that in cases of compound fracture, where legitimate attempts have been made to save the limb, the most general cause of a fatal result is pyæmia, not exhausting discharge, or even gangrene, which are comparatively rare ; and, consequently, if we delayed in more hopeless cases, we should probably never have the opportunity for the secondary operation to which they would have us trust.

I would merely refer to the fatal cases of amputation of the thigh, as showing the nature of the accidents requiring this operation as their only chance for life, and as exemplifying what

I have said as to the causes which influence the mortality of the greater primary amputations.

First, we have the case of a poor girl, caught by machinery ; her thigh crushed, the perinæum lacerated, and then brought into the hospital from a very considerable distance, the amputation requiring to be performed through the trochanters.

Next, we have the case of the man R——, who had one leg torn off, and the other crushed and mutilated by a railway truck, who had lost much blood and lain exposed, no one could exactly say how long, but at least an hour and a half, in one of the coldest nights of last winter, and both of whose thighs required to be amputated immediately. The third fatal case, that of John Reilly, was one where the amount of injury was less than in either of the former, it being a compound fracture extending into the knee-joint, caused by a railway waggon passing over the leg ; this man was brought from a distance, and had lost some blood, though not, I believe, a large amount, before reaching the hospital. Although much depressed at first, he went on very favourably till the end of the third week, when symptoms of pyæmia set in rather suddenly and destroyed him. But here, as in all cases of railway accident, I suspect the general shock is much greater than it appears, and tells ultimately on the constitution. I have noticed that even the less severe compound fractures so caused not unfrequently terminate fatally by pyæmia, after seeming to progress favourably for two or three weeks. A circumstance connected with this very case seems to show how severe the shock may be without any very extensive local injury. It happened that the young man who succeeded Reilly in his post at the railway met with a similar accident about eight days afterwards, and was also sent to be under my care. On admission he was pale and collapsed ; he had stimulants administered, and when I saw him, six hours after the accident, he had revived ; and as I found he had suffered a compound fracture into the knee-joint, I had him removed into the operating-room for the purpose of amputating the limb ; but as he was about to be lifted from the basket, I observed his face very pale, and on feel-

ing the pulse it had become so weak, that I desired him to be left, and stimulants and heat to the surface to be applied. I waited with him for above an hour, but he still continued in the same collapsed state. I then ordered the treatment to be kept up, and left him, and on returning, two hours afterwards, I found he had just expired without ever rallying. I and all who saw him concluded he must have received some injury of the pelvis, or rupture of some internal organ, or had internal hæmorrhage ; but the most careful post-mortem examination of the body revealed nothing beyond the local injury and the shock to account for death. From this and other instances I would infer, as I have already said, that in cases of injury by great direct force, as by railway, or machinery, and gunshot, such a shock may be caused as may affect the powers of life immediately, as in this case, or more slowly and gradually leading to the form of pyæmia which proved fatal in Reilly.

The fourth case, that of R. B., is an example of a class which I have referred to in my lectures, where the surgeon is obliged to amputate at once, notwithstanding the depressed state of the patient, in consequence of bleeding going on amongst the textures of the limb.

In the successful case we have an example of a much greater amount of injury to the bones of the limb, as there was a greatly comminuted fracture of the femur, communicating with the knee-joint, and fracture of the bones of the leg, but caused by indirect violence from a fall ; and though much more advanced in life, and not of strong constitution the patient suffered comparatively little constitutional disturbance after the operation, whilst, had it been delayed, I have no doubt the result would have been very different. The fatal case of amputation of the leg is scarcely a fair example of primary amputation, as nearly thirty hours had elapsed since the injury before the operation was performed, the patient having been sent from a very long distance to town, conditions very different from what we have in cases of amputation performed soon after the injury. At the time this case was under my care, I operated in private on a female patient above sixty

years of age, on account of compound fracture into the ankle-joint ; she made an excellent recovery, but then the operation was done soon after the accident, and without removal of the patient.

PRIMARY AMPUTATION OF THIGH; DEATH FROM MORTIFICATION OF STUMP.—(*Cases referred to in Lecture lxxxvi. pp. 771, 772.*)

1. David Wallace, æt. 25, admitted August 11, 1854, on account of compound comminuted fracture of the bones of the leg. A heavy truck passed over his right leg about two P.M. The gentleman who first saw him applied a tourniquet, and had him sent into the hospital in a cart. He arrived at six P.M. He was pale, and his pulse very weak from loss of blood. On examination, the bones were found to be ground to pieces, just below the tuberosity of the tibia ; the muscles of the calf were divided and mixed up with fragments of bone ; the skin was entire, excepting on the front and on the outer side. Four oz. of brandy and $\mathfrak{z}$ i. of solution of morphia were administered. He was put under chloroform, and removed to the operating theatre, but nearly sank on the way, respiration and pulse ceasing almost wholly. He was allowed to awaken, and had two oz. of whisky as soon as he could swallow ; he was again put under chloroform, and amputation by flaps performed at the lower third of the thigh. During the operation he nearly sank. He was then removed to bed, and surrounded with hot bottles ; two oz. whisky and $\mathfrak{z}$ i. morphia were administered ; in a short time he vomited ; the morphia was repeated ; pulse 120, very weak. He rallied about three next morning, under the assiduous application of stimulants and warmth. In the afternoon the skin was warm and moist ; pallid hue gone. Ordered $\mathfrak{z}$ i. Sol. Mur. Morph., which he soon vomited ; Bismuth Alb. gr. x. He became very excited and restless ; the dressings came loose ; dry lint was applied. Three stitches were removed, as some oozing had taken place. He slept well during the night, but awoke weak and restless ; pulse 130. To have port wine $\mathfrak{z}$ ss. every hour, and Sol. Mur. Morph. $\mathfrak{z}$ i., and M. xx. every fourth hour, if necessary. The bowels were moved by enema. At five P.M. the pulse was 130, full. Slept soundly all afternoon. Sweated profusely, but felt quite comfortable. At seven P.M. he was found pale and collapsed, only semi-conscious. There was a foetid smell round the bed. There was a bluish line all around the stump above the dressings, and a row of phlyctenæ behind it ; the bandage was becoming tight. All dressings and stitches were removed. The stump, as high as the trochanters, was quite cold and emphysematous. A poultice was immediately applied all over it. Wine $\mathfrak{z}$ iv and whisky $\mathfrak{z}$ ij were given ; but the gangrene spread rapidly, and the patient died at half-past nine P.M.

No examination was allowed. Shortly after death the body became of a purplish hue, and emphysematous all over, especially the head and face.

2. Wm. G., æt. 30, was knocked down by a railway waggon, which passed over both his lower limbs. The right thigh was fractured in the lower third ; the soft parts were considerably bruised, and there was enormous

swelling from extravasation of blood into the textures of the limb. The leg was cold; no pulsation could be felt in the tibial vessels. The left leg and thigh were likewise much bruised and slightly lacerated. Amputation was performed through the upper third of the right thigh, by anterior and posterior flaps. A portion of the muscle in the stump sloughed; the ulceration extended towards the femoral artery, and on the ninth day opened into that vessel a little above the ligature, which remained attached. On raising the stump and applying cold, the hæmorrhage ceased; but it recurred six hours thereafter. Mr. Spence then cleared the vessel from the surrounding tissues, and applied a ligature above the bleeding point. The sloughs separated; the wound looked healthy, and partial adhesion had taken place; but matter formed extensively in the left thigh and leg, and, under this profuse discharge, the patient sank in the fourth week.

SECONDARY AMPUTATIONS OF THIGH FOR INJURY.

1. S. C., æt. 8, was admitted on the 15th of July with a compound fracture of the thigh between the middle and upper thirds, resulting from a fall into an area from a height of twenty feet. The wound in the integuments was very small; and the limb was placed in a long splint. Necrosis of a considerable portion of both the upper and lower fragments of the bone took place, and abscesses formed around the thigh with profuse purulent discharge. As the patient was evidently sinking from hectic caused by the profuse discharge, while the necrosed portions of bone had not separated, amputation was performed on the 26th of August, immediately below the trochanters, by antero-posterior flaps formed by transfixion. The case promised well for some time, but pyæmia set in, and death occurred on the 18th of September.

2. C. A., a strong healthy girl, æt. 16, was admitted on the 13th of July with a compound comminuted fracture of the leg, caused by a light butcher's cart having passed over the limb. Pulsation in tibials distinct; temperature of the foot good; no great bruising of soft parts. Several detached portions of bone were removed, and the limb placed in a Liston's splint. *July 17th.*—Gangrene of the limb having taken place, amputation was performed at the lower third of the thigh, by the long anterior flap. There was unusually little bleeding during the operation, and there was no sloughing or gangrene of the stump; but the patient took a rigor on the 20th, and died of pyæmia on the 29th.

3. M. J., æt. 16, while running from a ram, tripped, and fell. Her right limb lay across a narrow drain and against it the chief violence of the animal was directed. The butting against the knee was so severe as to separate the external condyle, and at the same time cause great distortion of the joint and extravasation of blood into the surrounding textures. At first the knee-joint was thought to be dislocated, and attempts were made to reduce it. She was sent into hospital next day. The limb was placed in a wire splint, and fomentations applied to the joint. For about three weeks the patient went on favourably, but the soft parts began to slough, and the joint was ultimately opened into. Thereafter, acute synovitis set in, accompanied with irritative fever and profuse unhealthy dis-

charge. In the beginning of the fifth week the symptoms assumed a hectic character. As the patient was evidently fast sinking, and as her only chance of life was amputation, the limb was removed by the modified circular method, through the middle of the thigh. She died a fortnight after the operation.

4. John B. A loaded waggon passed obliquely over his right thigh, fractured the external malleolus and astragalus, and caused great extravasation into the textures of the leg and foot. At first it was thought possible to save the limb, but by the following day it had become quite cold and perfectly numb. As it was impossible, under these circumstances, to amputate with safety below the knee, the operation was performed through the lower third of the thigh by the long anterior flap. Recovered.

Remarks.—The successful case, John B., may be considered rather as a deferred, than, properly speaking, a secondary amputation. The state of collapse in this patient rendered it doubtful whether the coldness of the injured limb might not depend upon the general depression of the circulation, rather than on the local lesions, and therefore I considered it prudent to wait until moderate reaction took place, before deciding as to the necessity for amputation.

REGIONAL SURGERY.

INJURIES OF HEAD.



LECTURE XCI.

Injuries of the Head—Anatomy of the Textures involved, viewed in its Normal and Pathological Aspects—Primary and Secondary Effects of Injuries—Wounds and Bruises of Scalp : their Varieties, Phenomena, Complications, and Treatment—Compression and Concussion of the Brain—Symptoms of Concussion : its General Treatment.

INJURIES OF THE HEAD.—Whilst each of the various forms of injury occurring in this region possesses its own peculiarities, their chief interest is derived from the effects they may induce, either primarily or secondarily, on the brain and its membranes : so that what appears at first a trifling injury may, unless carefully attended to, lead to a serious or even fatal result. Accordingly, in treating of injuries of the head, we require constantly to keep in mind the nature of the textures injured, and their relation to the brain and its membranes.

INJURIES OF THE SCALP have dangers which depend both on the character of the scalp-texture, and on its vascular connections with the cranial bones and the dura mater. The scalp is composed of several tissues closely connected. The skin is of close dense texture, and is united by slips of fibrous tissue to the occipito-frontalis, the broad tendinous or aponeurotic expansion of which forms a sort of central tendon to the anterior and posterior bellies of that muscle. The interstices between these fibrous connections are filled by a quantity of dense granular fat, and the tissues are largely supplied with blood-vessels and nerves. In the lateral region of the head, we find the strong temporal aponeurosis underlying the scalp. The deep surface of the

scalp presents a smooth layer of dense fibro-cellular structure, which is very loosely connected by a quantity of fine cellular tissues with the pericranium. This cellular tissue is largely permeated by blood-vessels, which enter the bones and communicate in the diploë with branches which ramify in the dura mater.

The anatomical structure of the scalp—its dense unyielding texture, its great vascularity and nervous supply, the large amount of fibrous and aponeurotic tissue which it contains blended intimately with the more highly organised textures, together with the vital connections existing between it and the cranial bones and membranes, have important bearings in relation to diagnosis, prognosis, and treatment of injuries occurring in the region ; and hence we always regard these, even when slight, as deserving of watchful attention.

Bruises of the scalp may prove troublesome, from the injury leading to inflammation and unhealthy suppuration, or being complicated by dangers arising from the force causing the bruise affecting the brain and its membranes, as in concussion.

The character of the swelling which follows extravasation from bruise of the scalp, deserves our attention in reference to diagnosis. If the deep surface of the scalp be ruptured and blood effused, such extravasation may and very often does spread over the whole extent of the head, causing enormous swelling on the cranium, bulging over the orbits, and posteriorly passing down towards the neck. This arises from the loose connection between the scalp and pericranium, permitting the blood to spread uninterruptedly. The appearance of the patient, in some cases, is frightful enough ; but, as a general rule, if rest be enjoined, and cold evaporating lotions applied at once, the blood is rapidly absorbed, and no bad consequences may result : the laxity of the connecting tissue allowing of great distension without injurious pressure on the pericranium and bone. Incisions to evacuate the extravasated blood can hardly be requisite, except the tension be very great, and attended with constitutional symptoms. When speaking of contusions, I have already pointed out the dangers attendant on opening collections of effused blood,

and in this region these dangers are aggravated by the close relation of the effusion to important parts. Should symptoms of inflammatory tension or of suppuration occur, then, of course, incisions are imperatively required ; and there should be no delay in making them freely, to evacuate putrid blood and pus.

In some rare cases, where the extravasation arises from rupture of a large artery, such as the occipital or temporal, a pulsatory motion is communicated to the swelling, as in false aneurism. In such cases, firm pressure applied over the trunk of the injured vessel, and cold lotions to the swelling, will generally suffice to effect a cure, without having recourse to more heroic measures.

When the extravasation takes place into the scalp-texture, instead of beneath it, the extravasation is limited, owing to the density and close connections of the different tissues forming the scalp. This peculiarity of structure gives rise to a peculiarity in the swelling, which might lead—indeed often has led—to error in diagnosis. As the extravasated blood coagulates in the interstitial texture of the scalp, the flattened swelling assumes an extreme hardness ; whilst towards its centre, where a portion of fluid blood or blood-serum exists, the swelling pits, and on pressure the finger feels as if it passed down through an opening or depression of the bone, and a depressed fracture is suspected. The diagnosis, however, is not in general difficult. If the finger be pressed firmly down, the fluid blood or serum is displaced, and the flat surface of the cranial bones is felt. The condition, however, when complicated with the existence of severe concussion or symptoms of compression, may prove perplexing, and even lead to unnecessarily active practice. When the real state of the case is ascertained, the extravasation requires very little treatment beyond perfect rest and the use of cold applications to the bruised part.

Wounds of the scalp, whether incised, punctured, or lacerated, are, from the nature of the texture wounded, more likely to be followed by erysipelatous inflammation than wounds in other parts of the body. At one time this risk was increased in consequence

of the method of treatment adopted. A great dread existed of the bad effects of sutures and ligatures in scalp wounds, and so they were dressed with pads of lint, plaster, and bandages. This excited irritation, and led to the very danger it was intended to obviate. A simple incised wound of the scalp will in general do well if treated on the same principles as any other incised wound. In all forms of scalp wounds the part should be shaved. Bleeding vessels must be secured, and as, in a dense texture like the scalp, the arteries cannot be readily drawn out to be tied, acupressure has been long employed for this purpose, and the needle used, as in harelip suture, to unite the edges of the wound. If the wound be large, points of interrupted silver suture should be used, as giving rise to little irritation, and dry cold, by means of ice in gutta-percha bags, may be applied with advantage for some time. This local treatment, combined with rest and attention to constitutional symptoms, will generally prevent the accession of erysipelas or other bad symptoms.

In punctured scalp wounds, where injury has been inflicted with some force—as for example when a person falls on a pike or a sharp-pointed stone, or when a sharp-pointed body projected with force strikes and perforates the scalp—we must be careful in our examination of the wound, as a punctured fracture of the bone (a most dangerous lesion) may be present, and would necessitate prompt and decided measures to avert bad consequences. Even in cases where there is only a punctured wound of the scalp, there is greater risk of erysipelatous inflammation or unhealthy suppuration following than in the incised wound. In such cases the proper treatment consists in applying dry cold to the part, enjoining a non-stimulating diet, and keeping the bowels freely open. Should inflammatory tension supervene, the punctured wound should be freely incised, with the view of at once relieving tension and depleting, and also of allowing any pus or putrefying blood to get free vent, poultices or warm water lint-dressing applied over the wound and neighbouring parts, until the acute stage has passed off, when gently stimulating lotions should be substituted. By

adopting the treatment I have indicated, we obviate the dangers arising from extension of erysipelas over the scalp, the lodgment of unhealthy pus and blood in the vicinity of the cranial bones, or of the important internal structures becoming affected by the continuity of vascular supply.

Lacerated scalp wounds are of very common occurrence, and unless carefully treated and watched may prove very serious. In many cases such wounds are very extensive, and present a most frightful and ghastly appearance. It does not, however, follow that these very extensive wounds are always the most dangerous, and we require to consider the whole circumstances to form some estimate of the risk in each case. A reference to what has been already said of the anatomy of the scalp will explain the peculiarities of such wounds. The close connection of the different textures composing the scalp, and the resistant character of the aponeurotic structure which enters so largely into its composition, may account for the circumstance that we rarely find large portions of the scalp torn away, even when the parts are much lacerated, as by machinery ; whilst the loose connection it has with the pericranium, admits of it being readily detached from the subjacent structures over a large surface without such injury as would impair its vitality. This also explains why it fortunately happens that the pericranium is seldom detached to any great extent in such wounds. Thus we often see half of the scalp stripped from the cranium, and hanging over the face or side of the head, and yet wonderfully little constitutional disturbance follows, and the wound, if properly treated, heals kindly. The treatment of lacerated wounds of the scalp must be conducted on the general principles laid down when speaking of lacerated wounds, bearing in mind the peculiarities of structure and connection already alluded to. In most cases of this kind, we find the torn and everted scalp covered with mud or dirt, as such injuries usually occur in consequence of persons falling from horseback and being dragged along the road, or from the head coming in contact with the wheel of a passing carriage or cart, or from the hair getting entangled in machinery. The injured scalp

and cranial surface require to be cleansed from all foreign substances, and then the scalp should be carefully re-adjusted, and maintained in position by points of silver wire suture. At one time this, as I have already said, was greatly objected to as being likely to cause erysipelas; but it is less likely to cause irritation than heavy dressings of plasters, pads of lint, and complex bandages. The surgeon sees the progress of the wound, and can remove any sutures that seem irritable. Discharge is prevented from accumulating; a piece of lint soaked in tepid water or some antiseptic lotion is merely laid over the part, and the patient is thus saved much pain and discomfort. Sutures I have used long before the introduction of silver wire sutures, and I never saw any irritation follow even when the ordinary silk was used; and though we do not expect such wounds to heal by the first intention, the sutures maintain the detached scalp in position until it gets 'a set,' if I may so speak. Whereas, if we do not employ stitches, the scalp falls away, contracts upon itself, and leaves a large gap; the edges of the wounded scalp become thick and everted; the healing process is very slow, and occasionally ulceration of the pericranium with head symptoms may arise in a scalp wound from neglect of accurate apposition at the first.

In cases where the scalp is contused and torn rather than detached, as in injuries inflicted with blunt weapons, the local treatment at first is the least important. Warm water lint-dressing should be applied to the wound at first, and simple or charcoal poultices afterwards, when suppuration or sloughing supervene. In such cases we require to be specially on the watch for the development of head symptoms, especially those which indicate suppuration within the cranium. Erysipelas with smart fever and delirium may occur, and often does so without great danger. The most dangerous cases are those in which all seems to be going on favourably until about the eighth or tenth day, when the patient complains of not feeling so well; then a distinct rigor or repeated chills are felt, followed by headache and a low delirium; the edges of the wound become glazed and everted, or the scalp around has a puffy appearance, and the bone is seen bare. The

delirium increases, and gradually the patient becomes comatose. In such cases there has probably been suppuration between the bone and dura mater, resulting from the continuity of vascular supply between that structure and the scalp. This result is liable to occur in all forms of scalp wound, and is one of the cases where the operation of trepan may be required to evacuate the pus ; but of this I shall have to speak hereafter.

In cases where a contused or lacerated wound of the scalp is in the vicinity of or involves a large artery like the temporal or occipital, without actually wounding the vessel, if the wound takes on an unhealthy action, secondary hæmorrhage may result from ulceration of vessel. As this may occur suddenly, we should secure the patient against the risk by placing an acupuncture needle below the artery at a healthy part, and this in no way interferes with the ordinary dressing of the wound.

In all cases of scalp wounds, when erysipelatous inflammation attended with much tension, supervenes, incisions must be made into the swollen scalp, and warm fomentations, such as those of chamomile flowers and hops applied to the head. Abscesses in or under the scalp texture must be opened early and freely, and the constitutional symptoms watched, and met by appropriate treatment.

Before proceeding to speak of the injuries of the cranial bones, it is necessary to consider the effects produced by the shock of force communicated to the brain, or those produced by laceration or compression of its substance, as these effects on the contained organs constitute the important feature in all forms of head injury.

There are two conditions, CONCUSSION and COMPRESSION, which we require specially to consider. These conditions are very different in their essential nature ; but the symptoms on which our diagnosis must be founded are not always well defined, owing to the less serious condition being often complicated with other lesions.

Concussion, pure and simple, means the effect produced on the brain substance and its circulation from the shock of a blow

fall, or other injury, without any recognisable lesion of its structure. By compression is understood the direct and obvious compression of the brain substance and its circulation, whether by depressed bone, as in fracture of the skull, or by fluids, such as blood, serum, or pus, effused within the cranium. In a case of simple concussion of the brain, the patient is insensible, the pulse weak, fluttering, and irregular. The respiration is also irregular, slower perhaps than usual, but not stertorous. The surface of the body is cold, the limbs are flaccid, and there is occasionally loss of power of the sphincter ani, and either retention or involuntary passage of urine. The pupils are not regularly affected; sometimes they are dilated, at others contracted, and occasionally one pupil is dilated and the other contracted. The general appearance of the patient, immediately after the injury, is that of extreme collapse, with insensibility more or less complete.

The insensibility of concussion, as contrasted with that of compression, differs in degree. In both cases the patient is unconscious, but, in concussion, the patient can be roused to indicate a perception of external stimuli; thus, by speaking loudly to him, he will try and respond, not by a coherent or even a very articulate answer, but still sufficiently to indicate a certain amount of consciousness. In complete compression the patient is comatose. There is no response to external stimuli, beyond the mere existence of irritability excited by those of a physical nature. Another difference is in the evanescence of the unconsciousness in concussion as compared with compression. In the former the insensibility naturally tends to pass away, unassisted by remedies, consciousness gradually returning. The first stage of concussion, or concussion proper, may last from a few minutes up to some hours. Gradually the pulse rises, the respiration becomes more regular, and the heat of surface returns. The patient becomes a little restless, and at last opens his eyes as a person awakened from a troubled sleep, stares round him, and after a time becomes sensible of his position. At the beginning of this second stage, as the insensibility begins to pass off, the patient

very generally vomits. Occasionally vomiting occurs immediately after the accident, but this is rare. The vomiting, in fact, is an evidence of the existence of some degree of sensibility.

After a short period, during which the patient seems restored to his natural health, another train of symptoms manifest themselves. The pulse becomes quick, sometimes hard and wiry, the skin hot and burning, and the patient complains of headache and thirst. Reactionary fever has set in. Such is the usual course of the phenomena observed in a case of concussion, when unaccompanied by any lesion of the brain, its membranes or their blood-vessels. When, on reaction, the circulation becomes excited, other symptoms may develop themselves; vessels which have been torn may then begin to bleed, and lead to compression of the brain; or inflammation of the brain or its membranes may supervene, and occasionally give rise to compression caused by effusion of lymph, serum, or purulent matter within the cranium; but these are effects which require to be considered specially.

The explanation of the symptoms in pure concussion is not very easy. These symptoms seem dependent on some temporary derangement of the brain substance, or its circulation, giving rise to functional disturbance of the sensorium, which gradually passes off with the subsidence of the shock which caused it. In cases where the symptoms are more severe and persistent, or lead to any permanent change in the mental or physical condition of the patient, we may infer that some organic lesion has complicated the injury. This view is borne out by what we see in cases of concussion, which terminate fatally, where usually laceration of the brain substance, or extravasation of blood into the brain is found. In the very rare cases where concussion terminates fatally without reaction occurring, and in which no obvious lesion is found, it is probable that the shock has affected not only the sensorium but also that portion of the nerve centres more essentially concerned in organic life. The late Mr. Vincent was of opinion, that the amount of danger in cases of concussion depended on the direction as well as on the degree of

the force causing the injury ; being greatest when transmitted in a line directed towards the base of the cranium, by which its effect is received on the central parts of the brain, and least when directed in a line at right angles to the vertical lines, the force being then transmitted from side to side on the upper part of the brain, producing but little disturbance of its functions. (See diagram, Fig. 1, Plate xlv.)

Concussion of the brain, when uncomplicated with organic lesion, rarely proves fatal in the early stage ; the dangers are chiefly due to those conditions which develop themselves during reaction, and it is against such that you must be on your guard ; but the treatment of the early stage of shock has important bearings on the after-risks, as it may influence materially the subsequent conditions.

First let me state succinctly and distinctly what I consider should be the treatment, and I will then give you my reasons for avoiding certain things which are sometimes done. Amongst the most important items of treatment are the abstaining from all avoidable movement of the patient, and maintaining him perfectly quiet. External warmth should be applied by means of hot bottles or heated bricks wrapped in flannel ; a sinapism may be applied to the epigastrium, and if the collapse is considerable, and the symptoms do not soon improve, a turpentine enema should be administered, which acts as a stimulus, and at the same time relieves the bowels if distended. No internal stimulants should be administered at this stage, unless in very exceptional circumstances. If we attempt to give them in the unconscious state of the patient, unless we use the stomach-tube, there is a chance of suffocation from inability to swallow, and if we administer stimulants by means of the tube we are liable to increase the violence of the reactionary stage and the risks incident to that. The opposite and even more dangerous interference by bleeding during this early stage of concussion is not so likely to be used as it once was. There are certain conditions supervening on concussion, in which depletion is indicated and is followed by marked benefit. But to withdraw

blood when, from the shock to the nervous system, the circulation is depressed and irregular, and life trembling in the balance, would be very likely to turn the scale the wrong way. I know there are cases on record where venesection has been practised in the first stage of concussion with apparently immediate relief; and I can quite understand that in a case of concussion in which the right side of the heart was distended, venesection might, by relieving the distended organ, benefit the patient; but the case would be marked by congestion of the veins of the neck. Besides, the risks are so evident and so great, that I think it safer to advise you to abstain from so dangerous a remedy. When reaction has fairly set in, absolute quietude must be enjoined, and prophylactic measures used to ward off over-excitement, and the effects which frequently follow concussion. Cold, by means of ice-bags or cold-water cloths, should be applied to the head, and hot bottles kept at the feet. The patient should be put on low diet, and the bowels kept freely open. Should the pulse become quick and hard, accompanied with headache, or very slow and laboured, with sluggish action of the iris, depletion should at once be employed, either by venesection, or by leeches applied behind the ears. The patient should be carefully watched, and any abnormal conditions met by appropriate treatment.

LECTURE XCII.

Rationale of Treatment of Head Injuries founded upon the Pathological Conditions attending them—The immediate and more remote Dangers following Reaction in Concussion : Symptoms attending them ; Indications to be derived from these—Active and Passive Extravasation : Diagnosis of its Site—Inflammation of the Brain and its Membranes—Suppuration within the Cranium—Evacuation of the Pus by Perforation.

I HAVE stated dogmatically the treatment which experience has convinced me to be that best suited to ward off subsequent evils, because I think that in cases of emergency it is well that young practitioners should have the general plan of treatment before them in a distinct and easily remembered form. But to enable you to understand the grounds on which the method of treatment is founded, requires me to proceed now to consider the dangers which are liable to follow on concussion, during or subsequent to the reactionary stage. These dangers are, first, internal hæmorrhage, in either an active or passive form, leading to compression or disease of the brain. Secondly, inflammation of the brain or its membranes, resulting in effusion of serum or coagulable lymph on the surface of the brain, softening of the brain substance, or the formation of purulent matter within the cranium.

The danger which is likely to follow most immediately during reaction, or after it is fairly established, is INTRACRANIAL HÆMORRHAGE, and I shall therefore begin by considering its causes and effects. The cause of intracranial extravasation in concussion may be said in general terms to be rupture of some blood-vessels, generally of small size, by the force which caused the concussion. During the state of shock and collapse the depressed state of the circulation prevents active bleeding ; but when reaction commences and proceeds, the circulation becomes excited, and then the ruptured vessels pour out their contents,

and lead to symptoms, the character of which will depend on the amount and site of the extravasated blood. If the extravasation be small in amount and situated in the brain substance, or on the surface of the brain, or in a thin layer within the arachnoid membrane, the symptoms at first may not be very urgent or marked, and any symptoms which have appeared may seem to pass off; yet the extravasated blood may, by exciting a chronic inflammatory action, lead to disease of the brain, and at a later period give rise to alteration in its functions, as evidenced by both objective and subjective symptoms, such as impaired vision, paralysis more or less complete of parts supplied by some of the intracranial nerves, loss of memory, or other mental disturbance, imbecility, or excitability.

The cases in which the urgent symptoms following concussion mark most clearly the occurrence of intracranial extravasation, are those in which the meningeal vessels are ruptured. In such cases the force causing the injury has separated the dura mater from the cranial bones at the point where the blow was received, or at the opposite part of the cranium, by the *contre-coup*. The minute or larger vascular connections between the bone and membranes are ruptured, and pour out their contents. These press inwards the dura mater, and the corresponding hemisphere of the brain, causing symptoms of compression. Such a case affords, of all

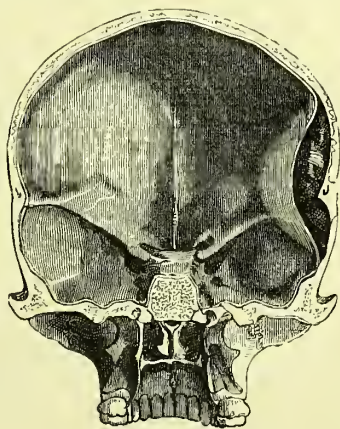


Fig. 3.

others, the best example of compression; and following, as the symptoms do, upon those of concussion, the distinctive characters and points of contrast between the two conditions are best studied. Suppose a case of concussion in which gradually the symptoms of insensibility and collapse have passed off. Moderate

reaction has occurred, and the patient has answered questions rationally, and expressed himself free from uneasiness. As reaction proceeds, the pulse rises, the face becomes flushed, and he complains of headache, and, perhaps, some sensation of noise as of rushing water, and becomes hot and restless. By and by he falls into a troubled sleep; gradually he becomes still, the sleep is noticed to be profound, and he snores deeply. At length the appearance of the features or the noisy character of the breathing alarms the friends, and they try to rouse him, but in vain, and the medical attendant is summoned. He finds the patient's pulse slow and laboured, the breathing stertorous, the pupils of the eyes dilated and insensible to light, and the eyelids and eyes insensible to the touch. The limbs are flaccid, though, in some cases, occasional convulsions and subsultus tendinum occur. The sphincters are relaxed, the patient passes his stools and urine involuntarily, or complete retention of urine takes place from loss of expulsive power. No noise, or question, however loudly put, nor even external stimulus, can rouse the patient, the state of coma being complete. In such a case the train of symptoms enables us to trace cause and effect. The original shock to the cranium, the insensibility caused by that passing away, the interval of consciousness, the excited circulation of reaction, followed by the gradually increasing coma of compression, leave no doubt as to what has taken place. It is a case of active intracranial hæmorrhage, leading to compression of the brain. Such a case points to the necessity for the watchful care and the prophylactic measures I have indicated during the stage of reaction following concussion.

The course and nature of the symptoms in this form of extravasation are so marked as to arrest the attention of even a careless observer. There is, however, another and more insidious form, that of *Passive* extravasation, of which I have seen many cases, and to the dangers and treatment of which I drew attention long ago, but more specially in my Clinical Report for 1859-60. This passive hæmorrhage very generally occurs from injury of some of the venous sinuses, but also from the smaller meningeal

Fig 1

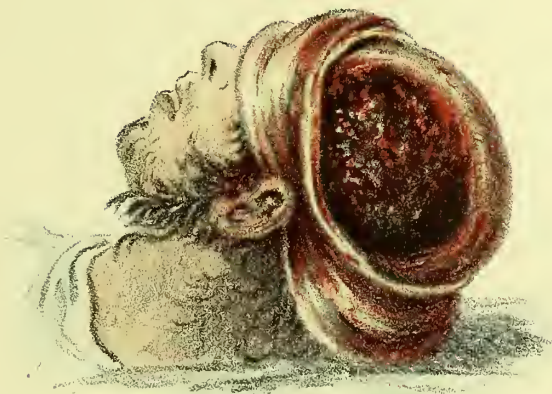


Fig 2



Fig 3



Fig 4



arteries. Its progress is insidious, and unless we are on the watch for danger, there is nothing in the appearance of the patient which would excite alarm. Generally, he seems to be suffering little from the injury ; complains, perhaps, of occasional headache, followed by a dull, uneasy sensation. If we examine carefully, we find that the pulse either never rises to the natural standard after the first stage of concussion has passed off, or what is more common, after having regained its natural frequency, it begins to fall to 60, 52, or 40 beats per minute ; this decrease following in a marked manner the occasional attacks of headache. The pupils become rather dilated, and, if tested by the application of light, contract in a sluggish and irregular manner. If these conditions be unnoticed or neglected, the patient, after the lapse of some days, may gradually become comatose ; or, more generally, excitement, delirium, squinting, and convulsions, precede by a few hours the symptoms of compression, which close the scene. The great danger in these cases is, as I have already said, that, owing to the slight general symptoms, and the trifling alterations in the state of the pulse in the early stages, the surgeon may neglect to guard against subsequent reaction, with its accompanying extravasation.

From what I have seen in the *post-mortem* examinations of cases in which the progress was such as I have described, I believe that the symptoms are due to a passive form of extravasation occurring at different times. Perhaps a certain amount of blood may have been poured out at the time of the accident, or slowly as the shock passed off, causing a slighter form of compression, as indicated by the somewhat dilated and sluggish pupil and the slow oppressed pulse. If no more extravasation occur, the symptoms may pass off without further bad effects ; but if the patient, feeling not very ill, be excited in any way, or allowed to move about, attacks of headache ensue. Each attack, attended by falling of the pulse, and greater dilatation and sluggishness of the pupil, marks the further effusion of blood. Next, the clot so increased in bulk, may, by its presence, excite irritation of the brain and its membranes ; and then we have the delirium and squinting

without apparent excitement of the pulse; but soon, as the escape of blood becomes more rapid from the restlessly excited state of the patient, sudden convulsions followed by complete compression result. In one fatal case, where the original injury was stated to be very slight, and where the patient could scarcely be made to see the necessity for any treatment, death occurred on the fifteenth day after the injury, preceded by excitement suddenly terminating in compression. On examination I found an enormous amount of blood effused, the greater portion of the mass being quite soft and evidently recent; whilst other portions, varying in consistence, showed that the extravasation had occurred at different times.*

Connecting these *post-mortem* appearances with the train of symptoms observed in such cases, I have long considered the slow oppressed pulse and sluggish pupil, especially when preceded by fits of headache, and the sensation described by patients, as being like a "rushing sound or feeling" in the head, as indications for diminishing the force of the cerebral circulation, so as to prevent further extravasation. The means I use to fulfil this indication are, depletion by means of leeches applied to the mastoid region; venesection in severe cases, or where the patient is young and strong; cold applications to the head, and free purgation. In a great many cases, if leeches be applied to the mastoid region, when the pulse is first noticed becoming slow, after reaction has been established, they will be found sufficient, if combined with cold to the head and the use of purgatives; but if the symptoms threaten to recur, the leeching should be repeated. In severe cases I have found most decided benefit from venesection, in alleviating the dull headache and tendency to coma, at the same time relieving the cerebral oppression, as evidenced by the slow, laboured pulse soon becoming more normal, and by the rapid improvement of all the other symptoms. In young and robust persons I have repeated the bleeding with advantage; but even in those of more advanced age or weaker constitution, it may be practised with perfect safety, if

* See Clinical Cases.

we carefully watch its effects, seeing that we can arrest the depletion when we please.

If antimony could be employed without the risk of inducing vomiting, it would be serviceable in preventing reaction after depletion ; but, unfortunately, even in minute doses, it is so uncertain in this respect, that I seldom have recourse to it.

At a more remote period after the injury has been received—from the fifteenth to the twentieth day, or later—a similar train of symptoms, though less marked, sets in, depending, I believe, upon serous effusion from subacute or chronic congestion of the vessels of the membranes. In those cases, blisters to the nape of the neck or occipital region, combined with the use of mercurials and laxatives, will generally be found the most efficacious plan of treatment ; but even at this stage I have occasionally had recourse to leeches with great benefit.

In regard to the position of the extravasated blood, in all forms of intracranial hæmorrhage, that is very uncertain. It may be between the bone and dura mater at the part struck, or at the point directly opposite, on the other side of the cranium, or it may be within the membranes of the brain, or in the substance of the brain. In the cases where the blood is poured out between the bone and dura mater, the clot is more localised and circumscribed, and within reach of surgical interference, if only we had some definite indication of its position. In general, the urgency of the symptoms and the position of the seat of the injury, in relation to the middle meningeal artery or its branches, form the only warrant for the surgeon to have recourse to the operation of trephine to enable him to remove the clot, and so relieve the brain, but there must always be uncertainty. In a case of active intracranial hæmorrhage, where the compression is complete and no amelioration follows the use of remedies, such as cold applications, depletion, and purgation, and where the seat of the injury is over or near the line of a large meningeal vessel, the operation ought to be resorted to as giving a chance for life. If the extravasation were not found there, I would even go the length of repeating the perforation at the point of contre-

coup ; but when the extravasation is within the membranes, the blood is so diffused towards the base of the brain that it could not be removed even if found, and hence operative measures are unwarrantable.

INFLAMMATION OF THE BRAIN OR ITS MEMBRANES, as a consequence of concussion, is the other danger which we have to guard against. In such cases, the train of symptoms and the period at which they supervene, are, in general, sufficiently diagnostic. Even in the passive form of extravasation, which I have alluded to, although some of the symptoms are those of excitement, and though the more marked symptoms of extravasation occur at a later period than in cases of active intracranial hæmorrhage, yet, when we are on the watch, the indications of extravasation are evident from the symptoms at an early period after reaction ; whereas, in the case of inflammation of the cerebral membranes or substance, the symptoms never appear immediately after reaction is established ; but generally from the sixth to the tenth day—seldom before the eighth day. Up to that date, the patient probably progresses well, complaining little of uneasiness beyond occasional attacks of headache, and without any great increase in the frequency of the pulse. The most common premonitory symptoms are anxious expression and sleeplessness, though these are not always present. About the sixth day the patient feels rather out of sorts, his appetite fails, the tongue is white and loaded, and he complains of headache, the character of which he describes as if a cord were tied round the head ; or else he complains of feeling a general tension about the head. The skin becomes hot and dry, and he has either a slight or well-marked rigor. The pulse becomes hard, wiry, and very frequent. Then follow intolerance of light and sound, and all the other symptoms of fever. The patient has an excited look, the eyes are restless and brilliant, and he starts and speaks during sleep. Delirium, generally of a violent frenzied character, supervenes. This state of matters, unless it yields to treatment, goes on increasingly, till it gradually terminates in low muttering delirium and coma. In some

cases, the symptoms indicate the formation of purulent matter within the cranium. After the phrenitic symptoms have lasted for some time, usually about the tenth or twelfth day from the receipt of the injury, a very decided rigor occurs, succeeded by perspiration. The general febrile symptoms are less, but there is a tendency to low muttering delirium, a semi-comatose state. Not unfrequently, paralysis, in the form of hemiplegia, or of some particular set of nerves, such as the facial, makes its appearance, and there are convulsions, subsultus tendinum, and these culminate in symptoms of compression.

These latter symptoms may arise either from effusion of serum or lymph on the surface of the brain or into the ventricles, or from suppuration and effusion of purulent matter between the bones and dura mater, or into the cavity of the arachnoid. In the cases where the effusion is either into the cavity of the arachnoid or sub-arachnoid, any surgical interference can be of little use, as the fluid, whether serous or sero-purulent, is generally diffused, and cannot be thoroughly evacuated. When, however, it is situated between the bone and dura mater, it is more likely to be localised, and may be evacuated by operation. It is therefore of importance to note any indication which may guide us to the position of the effused matter. Unfortunately, such indications as we have are neither very decided nor satisfactory as to the exact locality of the effusion. Hemiplegia is so far a general indication as evidencing pressure on the brain, and it is also usually indicative that the matter is situated over the hemisphere of the brain opposite to the paralysed side ; yet, in several cases, the contrary has been found to be the case ; and again, it may arise from sub-arachnoid effusion, or abscess in the brain substance itself. Mr. Pott, in his great work on injuries of the head, drew attention to the state of the scalp in certain cases, as indicating, in conjunction with the other symptoms, the position of pus, when placed between the bone and dura mater. He stated that in such cases the suppuration between the bone and dura mater affected the vitality of the bone ; and that, owing to vascular connections, the pericranium would also suffer, and

hence that unhealthy suppuration would occur under the scalp at the affected point. That in such cases, if the scalp was entire, a puffy or boggy tumour occurred at the part, or if a wound of the scalp existed, as the internal diseased action proceeded, the external wound became unhealthy, its edges everted, the discharge thin and gleety, and the bone could be seen bare at the bottom of the wound, and that the intracranial suppuration would be found to correspond. The "puffy tumour" of Pott has not been considered by recent authors as being much to be depended on as a diagnostic, and is spoken of as being rarely met with. My experience has been different. I have had occasion to trephine in several cases for purulent matter, and in these cases, one or other of the conditions described by Pott served as my guide to the pus. I suspect the term "puffy tumour" may possibly have led some to expect the presence of a distinct prominent swelling. In some cases it is so, but most generally it is merely a boggy tumefaction or flattened swelling under and in the scalp tissue at the part corresponding to the internal collection of pus.

As regards the value of the indications alluded to, it must be obvious that they are not absolutely certain. A simple contusion of the scalp tissue may be followed by suppuration of unhealthy character, and give rise to a boggy swelling; or a scalp wound, in which the pericranium has suffered, may be followed by necrosis of the surface of the bone, and then the wound would present the unhealthy appearance described, and it may so happen that the general head symptoms may be coincident with such local symptoms. It is quite true that suppuration between the bone and dura mater may occur without these local conditions, and also, that when they are present, perforation of the cranium may disclose nothing beyond a sloughy state of the dura mater, and perhaps a thin layer of yellow lymph, scarcely purulent matter. Still, as a general practical rule, if we have the symptoms of intracranial suppuration, and one or other of these local conditions be present, they form the best guides the surgeon has as to the position of the suspected purulent collection. My own opinion is, that the

cases in which these local conditions described by Pott exist, are cases in which the cranial bone and its pericranium have suffered severe contusion, followed by inflammation of the internal membrane, and hence the distinctly localised result; whilst, in cases where general meningitis follows concussion and terminates in suppuration between the bone and dura mater, these local indications may be absent.

The *Treatment* of inflammation of the brain or its membranes requires to be active, and to be successful must deal with the disease in its early stage. Indeed, here, as in regard to intracranial extravasation, prophylactic treatment during and after the stage of reaction is that which is of most avail; and hence the surgeon should never look on any injury of the head as too slight for anxiety and watchfulness. He ought always to bear in mind, that the diseased condition may supervene very insidiously, and that the diagnostic symptoms rarely occur till a week or ten days after the injury, sometimes much later; hence the necessity for quiet, and careful regimen, even when all seems going on favourably.

In the early stage of meningeal inflammation, the most perfect quietude is essential, and the light of the apartment should be subdued. Cold applications, such as ice-bags, or iced-water cloths, should be kept at the head. The bowels should be thoroughly cleared out by a purgative and an enema, and subsequently alterative doses of calomel or grey powder may be occasionally prescribed with advantage. When the headache is severe, and the face flushed, depletion by means of leeches, or even by venesection, should be had recourse to; for, however unfashionable the practice may now be, I know from experience that it relieves congestion and affords relief. The assistance of antimony can rarely be obtained, as it is apt to induce vomiting. Aconite (Fleming's tincture), in small doses of a drop, or half a drop, in water, every three hours, may be used with greater safety, to keep down the circulation after the depletion. When the restlessness is very great, and there is delirium and excitement, opiates may be given with advantage, though, as a general rule,

we wish to avoid their use in head cases. In several instances of watchfulness, restlessness, and delirium, I have found excellent results follow the use of bromide of potassium in large doses and I prefer it to opium in such cases. In the later stages of the diseased action, when we have muttering delirium, slight paralysis, or a tendency to coma, and in which the originally contracted pupils have become dilated, and do not answer readily to the stimulus of light—in other words, when we have reason to suspect effusion either of serum or lymph—the use of a blister to the nape of the neck, or over the scalp, produces often very marked benefit, and it should be applied before the symptoms have made much progress. Mercurials may also be of use in this stage, to promote absorption of any plastic effusion. The diet requires to be carefully attended to. At first it should be strictly antiphlogistic, but in the later stages we often require to give stimulants and animal soup to support the patient ; and, in most cases, when the more urgent symptoms have been subdued and the tongue become tolerably clean, the exhibition of quinine as a tonic will be found of great service in promoting convalescence, and relieving the peculiar nervous headache which is generally present. The quinine should be given in small doses at first, combined with dilute nitric or nitro-muriatic acid, and the dose gradually increased up to three or four grains twice or thrice a day.

When the symptoms arise which indicate that the inflammatory action has terminated in suppuration within the cranium, we must consider whether we can by perforation of the cranium reach and evacuate the pus. I have already pointed out the two conditions which, in my opinion, form the best guides as to the locality of the purulent collection, when situated between the bone and the dura mater. When we have either the puffy tumour or the unhealthy wound and bare bone at the site of injury, or even when there is tenderness of the scalp at one point, as evidenced by the effect of pressure, and when the symptoms are evidently progressing unfavourably, I think our plain duty is to give the patient what little chance

there is for life, and his chance will be all the better that we do not delay the operation too long. If we wait till symptoms of complete compression arise, we wait too long. The amount of pus present is very seldom such as would cause compression of itself, and when that condition supervenes, in connection with suppuration, it will be found to be chiefly due to the inflammation extending to the arachnoid and pia mater, and leading to serous or plastic effusion on the surface and into the ventricles of the brain, and not to the purulent collection between the bone and dura mater. Indeed, so far as I have noticed, the symptoms of complete compression are rarely if ever present in such cases till just before death. The symptoms are generally semi-consciousness, irritability, and occasional convulsions or facial paralysis, together with the severe rigors which precede these symptoms and recur from time to time.

Even under the most favourable circumstances, the operation of trepan, when performed for the purpose of evacuating intracranial purulent collections, cannot be expected to furnish many successful results. The very existence of pus, and the symptoms which warrant the surgeon in performing the operation, indicate that inflammation of the membranes has been proceeding for some time, and argue the existence of such morbid processes as are most unfavourable as regards the prospect of recovery. Even when we find and evacuate a purulent collection between the bone and membrane, we can never be sure whether, or to what extent, the brain itself may have suffered from the diseased action. Hence the operation can only be regarded as a chance afforded to a patient under otherwise desperate circumstances. But we must take care that we give that chance for life in good time, and not wait till there is no reasonable hope left, and when the result can only bring discredit on the operation.

In one case, on which I operated early, and where the symptoms had not fully developed themselves, only a very little sero-purulent matter escaped, yet the patient mended from the time of the operation.

In speaking of the conditions of concussion and compression,

I have, for the sake of description, taken typical cases of each ; but I stated at first, that we frequently meet with cases of severe concussion, in which the symptoms are not easily distinguished from those of compression. Thus, in some cases of concussion, the insensibility is very profound, and the pupils dilated, and the patient passes his stools and urine involuntarily. In other cases, we have the deep unconsciousness, together with convulsions and strabismus. Such symptoms indicate pretty clearly that there is something more than mere cerebral shock ; that there is either lesion of the brain substance, or that some extravasation has taken place at the time of the injury, and hence the mixture of symptoms of compression with those of concussion. In cases in which convulsions and strabismus are marked symptoms, whether after concussion or fracture of the cranium, they indicate laceration of the brain substance, generally towards the centre or base of the organ, and the result is almost uniformly fatal.

LECTURE XCIII.

Injuries of the Cranial Bones—Contusions—Fractures—Ecrasement or Smash—Fractures with and without Depression, as Fissures, and Simple, Compound, Compound Comminuted, and Punctured Fractures—Fractures of Base of Skull—General Symptoms and Treatment exemplified by Cases.

THE effects of injuries of the cranial bones come next to be considered. For the sake of brevity, I shall treat of them under the heads of Contusion and Fracture.

CONTUSION OF THE CRANIAL BONES is almost invariably combined with more or less severe concussion, and it may be attended by internal extravasation and other results of concussion already alluded to. More especially, I believe it to be the form of injury most likely to lead to suppuration between the bone and dura mater, in consequence of the impaired vitality of the bone, and its separation from the pericranial and meningeal connections, giving rise to unhealthy action. These conditions having been already fully considered, I will, under this head, merely allude to the fact, that contusion of the cranial bones, apart from the more immediate and urgent conditions already spoken of, may give rise to chronic affections of a serious nature, from cario-necrosis of the injured bone leading to alteration of the membranes of the brain and erysipeloid affections of the scalp ; or, the injured bone may become thickened, or irregularly nodulated on its internal surface, so as to press upon and excite chronic disease of the brain itself. In such cases epileptic attacks are very commonly the result ; and occasionally intermittent maniacal symptoms supervene, when, from any exciting cause, an exacerbation of the chronic otitis is induced.

I need hardly say, that when once such a state of matters is established, our remedies are not very efficacious, and that we

must trust chiefly to the prophylactic measures recommended when treating of the effects of concussion ; and to the active treatment of the early or acute stage of the inflammation which follows the contusion. In cases of chronic cranial osteitis following contusion, in which, from the attacks of headache and excitement, and the external tenderness of the scalp and bone, we suspect or ascertain that bone is the seat of inflammatory thickening, depletion by leeches, or, better still, by incisions through the scalp over the affected bone, will be found to afford great relief and, if followed up by the use of a course of iodide of potassium, and, at a later period, by the application of repeated blisters, permanent benefit may be effected. In certain cases, where epileptic fits have followed contusion of the bone, and especially if there be marked tenderness on pressure, or a tendency to the fits being induced by such pressure, the operation of trephining the bone, with a view of removing the source of cerebral irritation, has occasionally succeeded in effecting a cure ; but it has frequently failed ; and, as the risk of a fatal issue is considerable, I would not counsel you to have recourse to it except in severe cases, when the local irritation is well marked.

FRACTURE OF THE CRANIUM, even in its slightest form, is an injury attended with very great risk, because the existence of such a lesion indicates an amount of force applied to the cranium which would be likely to lead to serious results. It is well, however, to bear in mind, in reference to fractures of the cranial bones, that there is nothing peculiarly dangerous in the fracture itself, but that the danger is owing to the relation of the injured bone to the brain, and that this consideration is what influences our treatment of such injuries.

Fractures of the cranium are classified according to their position or character. Thus, in reference to position, we have them divided into fractures of the cranial vault, and fractures of the base of the cranium—an important classification practically, as the former division includes fractures of those portions of the skull which admit of direct surgical interference by operative

procedure ; the latter, those in which our treatment is limited to indirect measures, owing to the position of the injury.

The classification of fractures of the skull, according to their characters, includes, first, their condition as simple or compound, conditions which, though important in all fractures, are very specially so in cranial fractures, as influencing in a marked manner our treatment of the cases. Lastly, the subdivisions of cranial fractures founded upon their peculiar characters, are—fracture without depression, which includes the different degrees of fissure ; simple fracture with depression ; compound fracture, with depression ; and compound comminuted fracture with depression ; punctured or stellate fracture ; and lastly, what is termed by French surgeons *ecrasement* or *smash*, extensive comminuted fracture of the cranium. Fracture of one of the tables of the skull may occur without fracture of the other, and occasionally it happens that the internal is the table injured, whilst the outer has escaped injury.

Fissure of the bones of the cranial vault varies from a mere capillary fissure to a fissured fracture without depression, extending throughout the whole length and thickness of one of the bones, or even passing through several bones and the connecting sutures. Such an injury may be followed by grave danger, from the force which inflicted it affecting the contained organs, and leading to intra-cranial extravasation or inflammation. Hence a necessity for prophylactic measures, and for watching the patient for some time in case of mischief arising. But a fissured fracture neither admits of nor requires any interference with the fractured bone, except in cases in which compression from extravasation occurs, and in which the fissure traverses the course of a large blood-vessel,—as for example, a fissure through the anterior and lower part of the parietal bone. In that case, the existence of the fissure is a warrant for trephining, with the view of removing the extravasated blood. In cases of fissured fracture, we sometimes find the fissure at the opposite point of the vault from that on which the injury was received ; and not unfrequently we have fissure both at the point struck

and at the opposite side. Fracture without depression is merely a severe form of fissure.

The importance of depression in fracture of the cranium, whether simple or compound, is in proportion to the amount of displacement in the level of the bone, and consequent pressure on the brain. The extent of the depressed surface does not seem to affect the cerebral functions so much as the abrupt depression of a smaller portion, and does not in general so urgently demand operative interference. It is wonderful how the brain seems gradually to accommodate itself to a very considerable depression, diffused over a large surface, unless the depression be very deep. In children and young persons, the cranial bones are soft and elastic, and after a time, regain nearly their normal level ; but, even in adults, the effects produced by depression of a large surface, are less severe and more transitory than we might expect, and this is one reason which causes the surgeon to be chary in trephining in such cases until other means have been tried. In simple fractures of this kind, especially in the young, no interference is warrantable at first, unless the symptoms of compression are very urgent, and resist other treatment. In such cases it will generally be found, that along with the depression of the bone, there is extravasation of blood. Indeed, the result of my own experience makes me doubt whether the displacement of the bone, in any ordinary depressed fracture of the vault of the cranium, ever causes complete compression. In many cases which I have seen, both of simple and compound fractures, with even abrupt depression, the symptoms of compression have been almost absent, and in none have they been so well marked as they are in cases of active intra-cranial hæmorrhage, whilst in others, in which the symptoms of compression increased and proved fatal, extravasation was uniformly present. In these last cases, indeed, the very progress of the symptoms enabled me to predict confidently that we would find extravasation superadded to the fracture.

In fractures at the base of the cranium, the case is somewhat different, for in such injuries the broken bones are projected upwards, and impinge directly on the most important parts of the

brain, and so may produce more urgent symptoms ; but here, also, besides the fracture, there is usually extravasation from injury of the vessels at the base of the skull.

Simple fracture with depression varies in degree, and the intensity of the symptoms of cerebral lesion or of compression will depend, as I have just said, partly on the extent, but principally on the depth of the depression, and whether it be complicated with intracranial extravasation or fissure extending from the fracture towards or through the base of the skull. When limited, and the depression not deep and uncomplicated with internal hæmorrhage, the symptoms present at first may be merely those of concussion, or of a very slight degree of compression, which, under treatment, will pass away. If, in such a case, the symptoms, instead of diminishing, gradually assume the more decided characters of compression, this increase is pretty clear evidence that the cause of the increased compression is due to extravasation of blood from lacerated vessels, and not to the fracture, as the compression caused by the depressed bone would take place at once and not increase. Indeed, the brain gradually accommodates itself to the compression, originally caused by depressed bone. In children, owing to the soft resilient character of the cranial bones, what was originally a deep depression often disappears, or at least the depressed surface so nearly regains its natural level as not to cause any inconvenience, and scarcely to be perceptible to the touch. The correct diagnosis of simple fractures of the cranial bones is most important, as the extravasation into or under the scalp tissue, which has already been spoken of, might mislead the surgeon to suppose there was depressed fracture when no such lesion existed, and so lead to dangerous practice.

Compound and compound comminuted fracture may be considered under the same head, as differing only in degree, for all cranial fractures, except simple fissures, are more or less comminuted. In compound fractures the wound of the scalp enables us to see and feel the extent and nature of the fracture, and to judge of the amount of the depression, and the probability of the existence of depressed sharp projecting points of bone or

loose fragments of the skull, and so guides us as to the treatment necessary. When the scalp wound is too small to enable us to examine the full extent of the fracture, it can be enlarged sufficiently for that purpose. In some cases, however, the external appearance of the bone might mislead, as, for example, when the injury has been inflicted with a sharp-edged missile, such as a quoit thrown with great force, the edges of the wound in the bone look comparatively smooth, and not much depressed, when in reality a narrow portion is driven in and impacted, and the internal table extensively broken up; and I have seen the same thing occur from the kick of a horse. In all cases, besides the appearance of the fracture, we must take into account the nature and degree of the force causing the injury.*

Punctured fractures are those in which the injury is inflicted by the patient falling from a height on some sharp-pointed body, as an angular piece of stone or the spike of a rail, or when the patient is forcibly struck on the cranium by some sharp-pointed body, as, for example, by a sharp fragment of rock projected by the explosion of a shot in mining, or by a pitch-fork falling from the top of a hay-rick, or similar causes. In such cases the accident looks trivial, as there is only a small scalp-wound, and a mere punctured depression or small hole seen in the outer table of the skull, and the patient suffers little or nothing at first; there is seldom even slight concussion. The inner or vitreous table of the skull, however, suffers in general to a much greater extent. It is either projected inwards in an angular

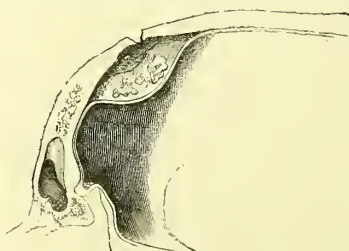


Fig. 4.

manner on the dura mater, or extensively comminuted in a star-like or radiating manner, numerous loose detached portions lying between the bone and dura mater, which is separated more or less extensively by the projecting force. Hence the term stellate or

radiating fracture is sometimes used to denote this form of punctured fracture (Fig. 4).

* See Clinical Cases.

The usual explanation of these effects of a punctured fracture of the cranium is, that whilst the outer fibrous and more resisting table of the skull is merely perforated, the extremely brittle, internal, or vitreous table is largely comminuted and projected inwards. The brittle character of the vitreous table no doubt explains to a certain extent the amount of comminution, but the real explanation of the effect produced is to be found in the direction of the force. Here, as in a bullet-wound, the point of entrance is small, the point of exit large, and the inner table driven aside in fragments. Any one may satisfy himself of this by inflicting forcibly on the dead subject a punctured fracture from the interior of the skull outwards, when it will be found that the outer table will be projected outwards, though perhaps not comminuted to the same extent as the vitreous table, when the punctured fracture is caused in the usual way, because in the latter both the direction of the force and the brittle texture of the internal table combine to produce great comminution. Suicidal gunshot wounds inflicted with a small pistol-ball, fired from within the mouth, cause large comminution and eversion of the outer table of the skull, when the ball perforates the cranium, showing the effects of the direction of the force causing the fracture. It is most essential to bear in mind the condition of the bone in punctured fracture in relation to the brain and its membranes, so as to understand the reasons which induce us to interfere at once in such fractures, although no bad symptoms may be present. In these cases it is indeed rare to have any untoward symptoms until six, eight, or ten days after the injury, when the usual symptoms—meningitis and intracranial suppuration—begin to manifest themselves.

Fracture of one of the tables of the skull may occur, but such injuries are rare. I have never in my own practice met with such an injury, and I should think it must almost be limited to the frontal bone, in which the divergence of the tables at the frontal sinuses might admit of the one yielding alone without implicating the other. Thus a direct blow might break the outer table over the frontal sinus, and the

inner not yield to the force ; or, in a fall on the occiput, the effect of the 'contre-coup' might split or fissure the inner table at the frontal sinus, without similarly affecting the outer table. In the case of the more serious lesion, fracture and probable comminution of the internal table alone—in which, as in punctured fracture, it would be proper to interfere if we could determine the existence and site of the fracture—I can scarcely conceive of any diagnostic symptom to warrant interference until those of intracranial suppuration begin to manifest themselves, and then the chances of successful interference would be small.

'Ecrasement,' or smash of the cranial bones, is usually the result of great force ; as when a person falls from a great height, or when a heavy weight or force crushes the skull, or as the result of a gunshot wound, as when a heavy charge of small shot strikes the vault of the cranium obliquely. In such cases, as may be readily conceived, the injury is almost immediately fatal. But there are degrees in this, as in every form of injury, and even most unlikely cases recover, as that of the girl J. S—r, which will be found in the *Clinical Cases*; so that we must never despair, even under unfavourable circumstances, but do what we can to assist the curative powers of nature.

In the *Treatment* of ordinary depressed fracture of the cranial vault, we must keep in mind that the danger depends on the relation of the bone to the brain and its membranes. In simple depressed fracture, even if there be symptoms of compression present at the time, we do not interfere immediately by trephining. We apply cold to the head, give purgatives, and in some cases deplete. If, notwithstanding these measures, the symptoms go on without improvement, then, especially in the adult, it is proper to cut down on the fracture, elevate the depressed bone, and remove any loose fragments which may be present ; but we are not warranted in doing this unless the symptoms of compression do not yield to treatment. In young patients we should be very slow to interfere, as the bones possess great elasticity, and the symptoms of compression may gradually pass off.

In a depressed compound fracture of the skull, in which the

bone is usually much broken up, and portions abruptly depressed, with, perhaps, a point of bone projecting inwards, we ought to lose no time in trephining, although symptoms of compression be slight or altogether wanting. Here we super-add no danger by operating. We are not converting a simple fracture into a compound one, as in the former case, whilst the benefit derived from elevating or removing the depressed portion or removing loose fragments is obvious. When the bone in a compound fracture is fissured, without being much comminuted or depressed, no one would think of trepanning at once, for no bad consequences may result from such a fissure, and the mere co-existence of a wound of the scalp does not greatly increase the danger. But when the fracture is comminuted or depressed, we should operate at once.

From what I have stated regarding the character of the punctured and stellate fracture, I trust you will see the propriety for promptitude in its treatment. You must not be beguiled into false security by the trivial appearance of the injury, or the absence of bad symptoms at the time. Keep in mind the state of the injured bone, and its relation to the brain and dura mater. It must be obvious to you that the projecting points of the table driven in upon the dura mater must irritate, if not lacerate that membrane, or even the brain itself, and that the detached fragments, deprived of their vitality, will act as foreign bodies, which, as they have no means of escape, must necessarily lead to intra-cranial inflammation and suppuration, unless an operation be performed to remove these sources of irritation. This, to be of service, should be done at once. If done early, we remove the fragments and depressed portions of the internal table before they have lacerated or punctured the dura mater, or excited inflammation, and so prevent bad consequences. If we wait till urgent symptoms supervene, our interference is too late, the mischief already done generally proves fatal. Although it is still our duty to give the patient a chance for life, as some few cases have recovered from removal of the fragments of bone, and escape of purulent matter, even when the operation has been

performed late, yet these are rare exceptions, and should not weigh with us as a reason for delay. The operation of trephining should be done at once, and all fragments of bone carefully removed; and when that is done the patients generally make good recoveries, and require little more than cold-water dressings to the wound, low diet, and attention to keep the bowels freely open, and, of course, absolute rest and quiet.

Fractures of the base of the cranium are the cases in which there is the greatest amount of compression and of danger, for, besides the extensive breaking up of the bone and projection of small fragments of it into the most important parts of the brain, there is a great risk of the vessels at the base of the brain being injured. Many, in fact, consider these fractures as fatal in all cases.

The general symptoms of such a fracture are those of compression with bleeding from the nose, mouth, and ear. When there is bleeding from the nostrils, the ethmoid bone is generally broken, and the anterior part of the base of the skull split up. A blow upon the nose with the fist may even cause fracture of

the base of the skull, by breaking up the ethmoid, nasal, and turbinated bones. In some cases of fracture of the base of the skull, the bleeding takes place from the ear only, and not from the nose or mouth. It must, however, be remembered, that bleedings from the nose, mouth, or ears, are not absolute diagnostics of this injury, as they may arise from rupture of the lining membranes of these parts in comparatively slight injuries. The force required to cause this

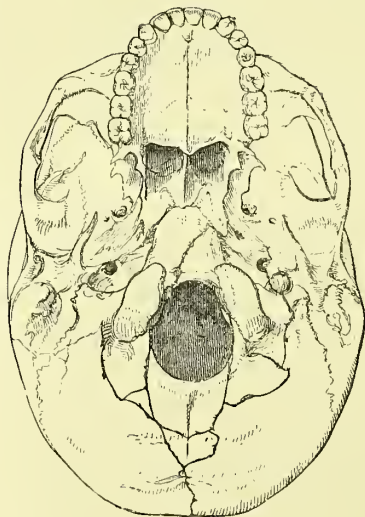


Fig. 5.

injury is very considerable. In some cases there may be a de-

pressed fracture on the vertex, and along with it extensive fissures passing down towards and causing fracture of the base of the cranium (see woodcut). The accident may occur from a person receiving a heavy blow upon the vertex, or from falling upon the occipital protuberance, fissures extending from the point struck to the base. Or it may occur from the patient falling in the sitting posture ; the head being still in motion is forced against the spinal column which has come to rest, and the base of the cranium is thus broken up extensively. Most generally it occurs from a fall upon the vertex, or from heavy bodies falling upon it. In some cases the symptoms are very intense : if the symptoms of compression do not come on at first, they soon do so ; when they are not very marked at first but become so subsequently, it is probable that effusion of blood has taken place secondarily, and caused the urgent symptoms of compression. These cases, as I have said, are considered by some to be almost uniformly fatal ; but my own experience does not confirm this, for several well-marked cases under my charge have recovered under proper treatment, and it is certainly not right to lay down such an absolute statement as to their fatality, as it might lead to a want of sufficient care in treating them.

The general treatment of fracture of the base of the skull is just that recommended for compression—the application of cold to the head, depletion to prevent further extravasation of blood taking place, absolute rest, and attention to the state of the bowels. By these means the very severe symptoms are often relieved. We can thus do something to prevent further extravasation of blood taking place to any great extent, and it is to that the fatal results are principally due.

It sometimes happens that in depressed fracture of the skull some sharp fragment may wound the longitudinal sinus, or the depression may be so situated that the operation for the elevation or removal of the depressed and comminuted bone may unavoidably implicate the sinus. In either case the complication is a serious one, but it is not now regarded with the dread it once was. Formerly it was supposed that the bleeding would be uncon-

trollable ; but experience has shown that, whilst the bleeding may prove dangerous in some instances, in many it is easily controlled. In my own practice I have met with five cases in which sharp fragments of bone had penetrated the longitudinal sinus ; in two of them the hæmorrhage was profuse and impetuous at first, but was not very difficult to control. One of the patients, a young lad, received a blow on the vertex with a piece of stone which was blown down with great force from the parapet of a high house. The bone was broken in fragments, most of which were loose and easily removed, except one which seemed driven across the line of the sagittal suture. It was impacted, and evidently must have wounded the sinus ; but it was absolutely necessary to remove it. The instant I withdrew the fragment a profuse gush of venous blood poured out from a large wound in the vessel, and the amount lost before I could put my finger on the opening was almost incredible, but the pressure of my finger at once arrested it. On moving the finger to apply a compress of lint, the blood again gushed out, but the lint, supported by a single turn of bandage tied from over the vertex and fastened under the chin, served completely to arrest it, and when the dressing was removed, forty-eight hours afterwards, there was no tendency to bleeding. In another case a man received a blow with a quoit, which struck him about the upper part of the occipital bone, inflicting a transverse wound about an inch and a half long across the line of the longitudinal sinus, near its confluence with the other sinuses. The bone was rather cut than fractured, and a portion of the margin, which had been indented, was drawn out along with the scalp, when I proceeded to examine the wound. On this being done a profuse gush of dark blood followed. I checked it at once with my finger ; but as I considered it necessary to examine the state of the bone in case of fragments of the inner table having been detached, I required to examine with a probe, and during the time I was so engaged, the bleeding was active, though not so violent as at first. Having satisfied myself that there were no loose fragments projected, I placed a compress of lint over the wound, applied ice-bags to the head, and kept the patient in the prone

position for some days, and under strict antiphlogistic treatment. He made a good recovery, and there was no more bleeding. In this case I was apprehensive lest the blood, prevented from escaping externally, might lead to intra-cranial extravasation and compression, and I had the patient carefully watched, determining to trephine in case of these conditions arising, but no occasion for interference occurred. Probably the attachments of the dura mater had not been separated by the force causing the injury. In the other cases the injuries of the sinus were merely punctures, and though the jet of venous blood was forcible, there was nothing like alarming hæmorrhage. In regard to the risk of trepanning over the sinus or close to it, I believe that unless the fractured bone has injured it, if due care be taken in using the trephine, the sinus may escape being wounded. I have twice trephined over the sinus, and in both cases the bone was removed without the upper membrane closing the sinus being opened. In cases where there are sharp shelving points of the internal table of the skull, the movement of the trephine in working it may cause injury to the sinus.

Although this complication is neither so much dreaded as formerly, nor should prevent the surgeon interfering in cases requiring operation for removal of fragments of bone, which must, if left, prove dangerous, still, as I have said, it is a serious complication, and apart from the risk of hæmorrhage, may lead to fatal phlebitis. In the case of the lad I have mentioned, who had fracture of the vertex, the head symptoms were mixed up with those of phlebitis, and when examined after death, the large sinuses presented fibrinous clots and broken down unhealthy matter exactly similar to what I found in a case in which I required to tie the internal jugular vein in a suicidal wound high in the neck, where the patient died undoubtedly from phlebotic pyæmia, so that the more prominent danger—hæmorrhage—is not the only or even the greatest risk of this complication.

LECTURE XCIV.

Hernia Cerebri : its Nature, Causes, and Treatment—The Operation of Trepan : Instruments required for, and Mode of performing it ; how modified by the Nature of the Injury—General After-treatment—Brief Statement of the Cases where Trepan should be performed.

FUNGUS, or HERNIA CEREBRI, is the term used to denote the fungoid protrusion which occasionally follows an aperture in the cranial vault, whether the opening has resulted from an operation such as trepan, or removing loose portions of fractured bone, or has arisen from disease leading to death and exfoliation of the bone. If, as sometimes happens in the case of injuries, the dura mater or the brain itself has been lacerated by the fractured bone, so soon as the bone is removed the pulsatory motion of the brain tends to project the brain substance through the lacerated membrane, and the aperture in the bone. In cases where the dura mater is entire, or merely punctured, the protrusion occurs more slowly. The membrane is projected against the sharp edges of the trephine wound, or the irregular margins left after removal of some loose fragments of fractured bone. This gives rise to irritation, interrupted circulation, and at last sloughing, of the dura mater, corresponding to the part whence the natural osseous support has been removed ; and then projection of the cerebral fungus gradually takes place. In some instances, as I have seen in gunshot fracture of the parietal bone, the dura mater, though not lacerated or wounded, has its vitality affected by the injury, and presents an opaque leathery appearance when the fragments of bone are removed ; the sloughing of the membrane takes place very rapidly, and a large though not very prominent fungus protrudes. (See Plate xliii. Figs. 2 and 3.) I believe, however, that in most, if not in all cases of fungus cerebri, there are other causes in operation besides those men-

tioned, and that laceration, extravasation, and most frequently unhealthy suppuration in the brain-substance underlying the protrusion, will be found present. These last-mentioned conditions were long ago pointed out by Abernethy and others, and Mr. Hill, in his *Surgical Cases*, details a case in which the fungus was accompanied by, and apparently depended on, abscess in the brain, and where, to relieve the symptoms, he was obliged to plunge an abscess-lancet into the brain to evacuate pus, and from time to time to shave off the fungus as it rose above the surface of the bone, and the patient ultimately recovered. My own experience is in accordance with this. In all the cases I have had an opportunity of examining, I have found a cavity in the softened brain-substance corresponding to the base of the protrusion, containing broken down disorganised clots and pus. I think it most probable that the extravasation at first, and subsequently the purulent collection, have been active agencies in causing the protrusion, by expanding the superjacent brain. As to the character of the protruded mass, I believe it varies in different cases. In all there will be found cerebral matter, but it varies in amount. In some, as those in which the dura mater has been torn, and the brain rapidly projected, the greatest part of the original protrusion consists of the cerebral substance, whilst in some, where the growth is more slow, and preceded by inflammation and ulceration of the dura mater, a very considerable part of the fungus may consist of fibrous structure, plastic lymph, and blood, with a smaller proportion of brain.

The state of a patient affected with fungus cerebri is always one of great danger; indeed recoveries are exceptional. Out of several cases in my own practice I have only met with one where the patient survived. In many cases the symptoms are not of a kind to excite alarm at first, but gradually, irritability and excitement come on, with rigors, and then the patient becomes convulsed or paralysed, at last semi-comatose, and continues in that state till he dies. In cases where it follows severe injury, as in the case of gunshot wound, from which the

sketch in Plate xliii. was taken, the patient, though he lives for a fortnight or longer, may never recover consciousness, and the fungoid protrusion apparently causes no alteration in his condition in any respect. In other cases the coma may become profound, and be accompanied by subsultus tendinum or convulsions and hemiplegia.

The method of treatment very generally adopted and recommended is the local application of pressure to repress the fungus, and general antiphlogistic regimen, and occasional anodynes, if there be much excitement. In the early part of my practice I gave this plan a fair trial, but I must say that I never saw it afford relief, and very generally it seemed to aggravate the symptoms, so that even the use of slight pressure could not be persisted in. I accordingly gave up the application of pressure in the early stage, and founding my practice upon the pathological conditions which I found in cases I had examined, and confirmed in my opinions by the views of Abernethy and the experience of Dr. Hill and others, I had recourse to shaving off the fungus even below the level of the opening in the bone, which I was enabled to do, as the cases I had to deal with were openings caused by comminuted fracture, largely exposing the dura mater. In two or three cases distinct, though only temporary, benefit was afforded by the escape of pus and grumous blood, and the fungus was scarcely reproduced. In other cases the symptoms of coma were relieved, and the tendency to protrusion gradually lessened, though no matter seemed to escape ; and I never have had any trouble from hæmorrhage or cerebral symptoms from cutting off the protrusion. After a time I use a thin fold of lint soaked with lime-water, or weak solution of tannin, and supported by a bandage or adhesive plaster, as a local application. Attention requires to be paid to diet ; and although, as a general rule, antiphlogistic regimen is required at first, and stimulants avoided for fear of exciting the circulation, yet after a time this must not be carried too far ; and in many instances I have seen temporary benefit derived from the use of quinine and a rather liberal diet, when the patient perspires much and

begins to be exhausted. After all, however, the very nature of the case gives but small chance of ultimate recovery. Here, as in many other diseases, our chance of success lies in prevention.

In cases of fracture in which portions of bone have been removed, or in cases where the operation of trephining has been performed, I have long been in the habit of using a modification of the repressive treatment advised by Sir Charles Bell. His plan, as applied to the trepan opening, was to fold a piece of lint several times, and mark it with the crown of the trephine with which the opening had been made. The lint was then cut to the shape and size of the circle, and the compress, so prepared was placed over and within the opening of the bone, and retained by a bandage, the object being to prevent the dura mater from being bulged into the aperture. Such a compress, however, gave rise to great irritation from direct pressure, and was unnecessarily powerful. After trephining, or removing fragments of fractured bone, the head having been previously shaved, I lay down the scalp close to the opening; and over the scalp and aperture I lay a portion of thin gutta percha tissue. Over this I place a flat piece of sponge, larger than the opening, wrung out of water, covering it with a layer of gutta percha; the edges of the upper and under layers of the gutta percha beyond the sponge are touched with chloroform, which makes them adhere, and then this light elastic compress is secured by a bandage or broad strip of adhesive plaster. This local treatment I have found most useful, as at once a clean and simple dressing, and as tending to repress the bulging upwards of the brain and dura mater against the margins of the aperture in the cranium. It should be combined with strict antiphlogistic treatment, purgation, and non-stimulating diet at first.

The operation of TREPAN or TREPHINING, strictly speaking, means the perforation of the cranium with the special instruments, the trepan or trephine; but the term, Operation of Trepan, is now very generally used to denote all operations on the cranium having for their object its perforation—the elevation of

depressed, or the removal of comminuted fragments of bone, whether performed with the trepan or other instruments.

The instruments required for the operation are not very numerous. The old trepan and trephining cases used to contain a great array of instruments, many of which are now never used: such were the rasparatory, for scraping off the pericranium; the perforator, for boring a hole to insert the centre-pin of the trephine and the lenticular. The last-mentioned instrument, however, may occasionally be useful; at least I can conceive a case where it might smooth off an irregular edge, but I have never used it myself. Certainly it should not be used in every case to smooth the edge of the trephine wound, as used to be done, as that is likely to do harm by unnecessarily separating the dura mater by the button at the end of the instrument. The instruments really necessary are—the trephines of different sizes, so arranged that they can be fitted to the handle of the trepan or trephine as required; trephine forceps fitted for removing the circle of bone cut by the trephine; an elevator; a “Hey’s saw;” bone-pliers; the lenticular; a small brush to clear the teeth of the trephine during the operation; a thin flat probe of wood or quill to examine the depth of different parts of the circle during the operation, and the usual apparatus of bistouries, sharp and probe pointed; dissecting and artery forceps, sponges, lint, etc.

The operation is modified by the nature of the causes requiring its performance, and as the simplest example of trepanning or trephining is perforation of the cranium for the purpose of evacuating blood or purulent matter, I shall first show you the method of procedure in such cases.

The operation consists essentially of three stages:—

- 1st. The incision of the scalp and pericranium.
- 2d. Section of the bone with the trepan or trephine.
- 3d. Evacuation of the extravasated blood or pus. In cases of depressed fracture, the 3d stage consists in elevating the depressed, and removing the loose fragments of bone.

In operating for evacuation of blood or pus, the line of

our incision of the scalp will often be determined for us by some wound in that texture. If, however, there be no wound of the scalp, or only a small one, then, if the evacuation of purulent matter be the object, I make a free crucial incision through the puffy or boggy scalp, so as at once to expose the bone and to allow the unhealthy infiltrated pus to escape from the scalp texture. In the case of operation for extravasated blood, I prefer a V-shaped incision, the apex pointing downwards, as the flap adjusts itself more readily afterwards. In either case, the vessels of the scalp which bleed should be secured before proceeding to the section of the bone. The size of the crown of the trephine, which is to be used for section, should be large, to facilitate the evacuation of the blood or pus. In the case of a fissure of the bone being discovered when we are trephining for extravasated blood, the centre pin of the trephine ought to be inserted close to the fissure, so as to make sure of including the line of the injured vessel, and to be able to secure it if possible after the evacuation of the coagula. When our object is to evacuate purulent matter, the crown of the trephine is placed over the denuded portion of bone, as that is most likely to correspond to the internal collection of pus.

The incision of the scalp having been made, I proceed to clear the bone for the saw; I divide the pericranium crucially, and then push it aside with the handle of the scalpel till I gain sufficient room to apply the trephine. Scraping off the pericranium, as used formerly to be done, is a most mischievous practice. The bone being now prepared for section, I apply the trephine; but you will observe that, before doing so, I project the centre pin, and fix it considerably beyond the line of the edge of the saw. I now press the centre pin firmly into the bone, and begin to work the trephine. When I remove the trephine, and find I have made a sufficiently deep groove to fix the saw, and allow it to work in the circle, I withdraw the centre pin within the crown of the trephine, for, if this were neglected, it would perforate the bone before the circular saw, and so injure the dura mater. After brushing out the detritus of the bone from the

teeth of the saw, I again resume the section of the bone; from time to time removing the trephine to clear its teeth, and also to ascertain the depth of section at different parts of the circle. In operating on the living, you must proceed very deliberately, and that is one reason I prefer the trephine to the trepan, as the ease with which the latter is worked is very apt to make the operator careless and lead to accidents. You will notice that I am now sawing with only one-half of the circle of the trephine, and using the instrument unevenly as it were. The reason is, that I found with the quill probe that my section was much deeper at the upper segment of the circle than at the lower. The form of the cranium leads to this. Again we must keep in mind the unequal thickness and hardness of the cranial bones, and carefully examine the section every now and then, and accommodate the pressure on the saw accordingly, elevating the teeth of the saw from that part of the circle where the section is deepest, and working more on those parts where the section is shallow. I now feel that the section is almost complete, and that if I used the trepan forceps or elevator I might remove it with a very little force, but that would leave an irregular margin, and might lead to irritation of the dura mater, so I continue to use the saw very lightly at the undivided part of the circle till I feel the bone loose, and then with the forceps I simply lift out the circle of bone. On the living, the blood or pus, if present between the bone and dura mater, would now be exposed, and the evacuation being effected, the scalp wound is closed, and dressed as I have recommended when speaking of *fungus cerebri*, or simply with tepid water lint laid over the part.

When the operation is required in cases of fracture of the cranium, our operative procedure is modified by the nature of the injury. In many cases the use of the trephine is not required. In largely comminuted fractures, for example, by getting out one fragment with the dissecting forceps, or raising an edge with the elevator, we gain room to elevate or extract other fragments. In other cases, by using the Hey's saw to cut across the base of some angular portion of the bone, which is sharply de-

Fig 6



Fig 4

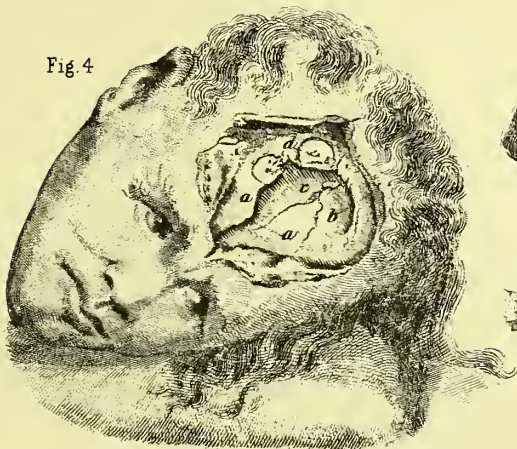


Fig 7



Fig 1



Fig 8

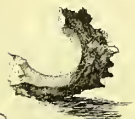


Fig 3

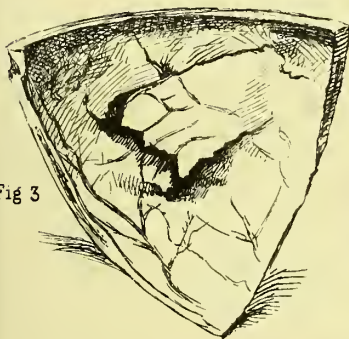


Fig 10



Fig 2

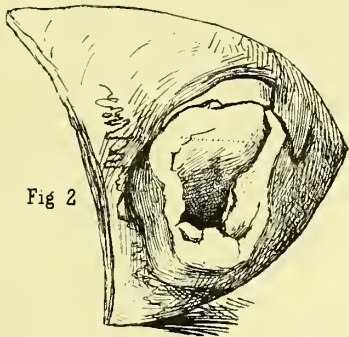


Fig 5

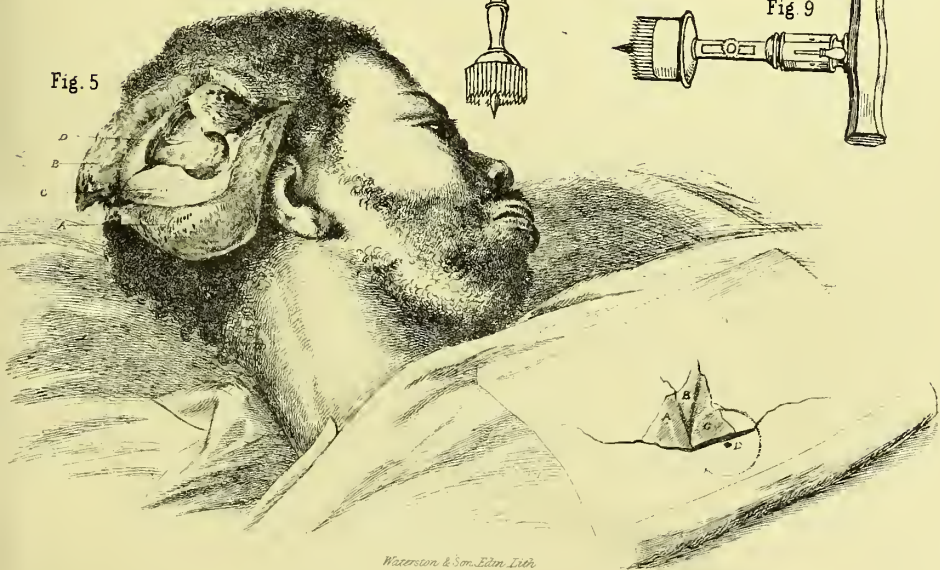
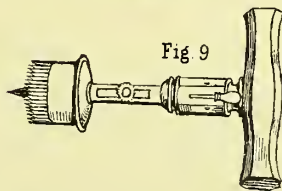


Fig 9





pressed, we are able to remove it and thus gain room to enable us to deal with the other portions, as on examination may seem best (see Plate xliv. Figs. 2, 3, and 4). When we require to use the trephine in fracture of the skull, whilst the general principles regarding its use are the same as I have already described when operating for evacuating for blood or pus, yet there are important modifications in its application which we must attend to. In cases of depressed fracture, it is usually recommended to place the crown of the trephine on the sound bone, close to the depressed edge, as represented in the accompanying woodcut, so as to get the elevator introduced below the depressed edge, to raise it, using the sound unfissured margin of the trephine wound as the fulcrum for the lever. If the object in view in such cases was always and only elevation of the depressed edge, the principle would be correct enough ; although even then we would frequently find, that, owing to the depressed edge carrying along with it a shelving portion of the internal table from the undepressed part of the bone on which the trephine had been placed, we might not be able to introduce or use the elevator without a further section being made.

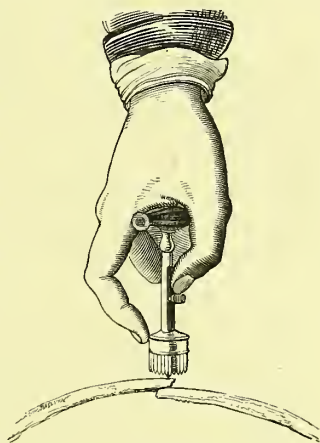


Fig. 6.

My own experience in a very considerable number of cases in which I have operated, and others where I have assisted in operations for depressed and comminuted fractures of the skull, enables me to state that the removal of detached and depressed portions of bone is much more generally necessitated than mere elevation of the depressed margin, and hence our application of the trephine should be arranged so as to enable us to effect both objects with as little removal of sound bone as possible. In many instances we can effect this, as I shall show you, without using the trephine at all ; but supposing

that, as often happens, we must use the trephine to get sufficient room, then attention to the usual conditions of fractures requiring trepan, will, I think, indicate that the instrument may be applied with greater advantage at a different point from that usually advised. In almost every case in which there is a deep and abruptly depressed point or margin of the fractured cranium, it will be found that the bone is fissured across the base of the depressed fragment. At the fissured part there is no shelving of the inner table, the bone is more or less completely cracked through in an even line; beyond the fissure the bone is perfectly sound and resistant. If the trephine be applied there, so as partly to overlap the fissured part, the sharp depressed fragment, with the shelving portion of the internal table, will be easily withdrawn, and other loose fragments removed, and any remaining depressed margins of the undetached parts of the bone can be as easily elevated. I have said, that in many cases of comminuted fracture we do not require to remove a circle of bone with the trephine, but can effect our purpose without sacrificing any sound bone. I will show you what I mean by operating on this comminuted fracture made on the subject, which enables me to exemplify exactly what would be required in such an injury in the living. You notice the fracture is comminuted and depressed, but that fragments are closely impacted. I choose this large triangular fragment, knowing that its removal will give me room, either to elevate the other depressed portions, or that, on its removal, these will be found loose, and be readily picked out. I now apply the cranial saw, known as Hey's saw, and with it, as you see, I saw across the base of the triangular piece of bone; next, with the dissecting forceps, or the thin point of the lever, I loosen it at the base, sides, and apex, and carefully remove it. This, you see, is a slow process, but now you perceive the effect. Most of the other fragments which were wedged in by it are now found to be loose, and I lift them out, elevate readily the other depressed margins, and next examine for and pick out those small scales of the internal table lying on the dura mater; and all

this is effected without removing any sound bone, and with the least possible disturbance of the parts.*

In trephining, in cases of punctured fracture, in which our chief object is to remove the depressed points and detached fragments of the internal table, corresponding to the puncture and radiating from it in all directions, I use a full-sized trephine, to permit of examination and easy extraction of the spicular portions of bone. To effect these objects, the puncture in the outer table of the skull should be the centre of the circle of bone to be removed. The objection to this, however, is, that to insert the centre pin of the trephine there would be very dangerous, but it is not necessary to use the centre pin. I take a piece of thin wood or moderately thick pasteboard or leather, and cut out a circular opening in it with the trephine I am about to use, and smooth the edges of the opening so made. I now place this over the part of the bone to be removed, the punctured wound of the bone being in the centre. The pasteboard is held firmly by an assistant until the trephine has made a sufficiently deep groove to work steadily in, and the section of the bone is then proceeded with as already described. In all cases of depressed fracture, but more especially in this form of injury, the trephine should be worked steadily and gently without jerking, as otherwise any unsteady movement might cause the shelving portions of the internal table to impinge upon and puncture the dura mater and even the brain itself. When the section is completed, the fragments—even the smallest—must be carefully picked out, and to make quite sure of removing all, without irritating too much the dura mater, I generally, after extracting the fragments that are visible, take a camel-hair pencil of large size slightly wetted, and introduce it under the margins of the bone, so as to sweep off any scales or debris of bone which may be lodged there.

Finally, in this and all other forms of depressed fracture in which we operate, the state of the dura mater should be examined before closing the wound; and in all such cases the

* See Clinical Cases.

plan of dressing the wound I recommended when speaking of the prevention of fungus cerebri, should be employed at first, and indeed in most cases throughout the cure.

The general after-treatment may be stated as antiphlogistic. Opium or other anodynes may be given to procure rest. At one time opium was considered as improper in head injuries, but if judiciously given, and its effects watched, it is often very beneficial. Ice to the head at first is of great use, both for modifying the circulation and as a sedative. In some, however, its effects are too depressing, and hence its action must be watched. In cases where we operate to evacuate purulent matter, the treatment must be modified in many cases. Nutrient diet and quinine, and even wine are often necessary, and instead of doing harm prove of the greatest benefit. In fine, the state of the individual patient must regulate our practice.

I have already stated, when speaking of the various injuries of the head, the circumstances which may require the surgeon to perform the operation of trephine, and the principles on which he acts in each case. But here, as in some other cases where emergency demands promptitude in action, I think it advisable, before leaving this important subject, to state succinctly, in a dogmatic form, the cases in which I would advise trepan to be performed :—

- 1st. *Without delay*, in all cases of distinct punctured fracture, to avert mischief by removing the fragments of the inner table.
- 2d. In cases of compound comminuted fracture, with depression (not in mere fissure, with wounded scalp).
- 3d. In simple depressed fracture, when, after a fair trial of other measures, the urgent symptoms of compression are persistent.
- 4th. In compression from extravasated blood, when the position of the injury or the existence of a fissured fracture indicate the probability of a large artery, such as the middle meningeal, having been torn.

- 5th. For intracranial suppuration, when the symptoms, and the existence of the puffy swelling or unhealthy state of the scalp-wound and bone give an indication of the probable position of the pus.
- 6th. In certain chronic cases, from disease or alteration in the bone following contusion or other injury causing cerebral symptoms, such as local paralysis or epileptic fits.

This last rule is by no means so imperative as the others.

LECTURE XCV.

Injuries of the Spine : their similarity to those of the Brain—Concussion of the Spine : Objective and Subjective Symptoms which characterise and accompany it ; Indications of Treatment—Fractures and Dislocations of the Spine : their Diagnosis, Prognosis, and Treatment—Tumours of the Scalp : Cystic, Fibro-Plastic, Malignant, Vascular-Erectile ; the Diagnosis and Treatment of each—Cirroid Aneurism or Arterial Varix—Necrosis of the Cranial Bones.

ALTHOUGH INJURIES OF THE SPINE may not be considered as belonging properly to the region of the head and neck, yet they are so similar in character to those of the head—the important feature being the implication of the nervous centres—that I think these injuries naturally come to be treated of in connection with each other. By doing so we will also save much needless repetition.

Like the brain, the spinal cord may suffer from concussion, without lesion of its substance, and from the effects induced by such injury. From compression caused by intraspinal extravasation, owing to laceration of vessels, in an injury causing concussion or fracture. From effusion, the result of inflammation of the spinal membranes after injury ; or from direct and forcible compression, caused by displacement of the vertebræ in fractures, and dislocations of the spinal column. It is also liable to undergo softening and alteration in structure from inflammatory affections of a chronic type, following slowly on comparatively slight injuries.

The pathological conditions in concussion and compression of the spinal marrow are strictly analogous to those which we traced in these conditions in relation to the brain. The symptoms vary, however, in consequence of the difference in the functions of this part of the cerebro-spinal system, and hence they also differ according as the injury implicates different points of the spinal cord—the general symptoms being those of interrupted nervous power to the parts below the seat of injury.

From the anatomical arrangement of the spinal canal and its contents, the small size, form, and firmer consistence of the medulla spinalis, as compared with the brain, and from the arrangement of its membranes and vessels, especially the large size of the rachidian veins, it must, I think, be obvious, that if the medulla or its membranes suffer any direct lesion, its structure is likely to be implicated to a greater extent, and the bad effects produced are more likely to be permanent, or even progressive, than is the case in head injuries. Even injuries of the interspinous and other ligaments, may, from their close connection with the lining membrane, be followed by chronic affections of the spinal marrow.

CONCUSSION OF THE SPINE may be caused in various ways, as by a person falling in the sitting posture, or backwards and striking the back against some projecting body, or by a person being suddenly and forcibly projected forwards, and then suffering from the violent recoil, as frequently happens in railway accidents. The symptoms produced will be more or less loss of motion, or sensation, or both, in the parts below the injured point. If the concussion be severe, and has affected the spine high up in the cervical region, life may be at once extinguished. More generally, however, the result is loss of power of the extremities and sphincter muscles, together with difficult respiration and priapism.

If the case has been merely one of concussion, the symptoms after some hours begin to pass off and gradually disappear; and if the patient be kept quiet, lying on the side or in the prone position, and cold applied to the spine by means of ice-bags when reaction sets in, no bad consequences may follow, if only the patient be very cautious for a length of time not to exert himself in any way. In other cases, if, after the original symptoms disappear, loss of nervous power again manifests itself, preceded by pain or uneasiness in the back, leeches should be at once applied, and the bleeding promoted by fomenting with sponges wrung out of hot water. Sub-

sequently cold should be applied to the spine as before, and absolute rest and non-stimulating diet strictly enforced. Great attention should be paid to the state of the bowels and urinary bladder.

The relapse of interrupted nervous function shortly after the original symptoms have passed off and reaction has occurred, points to intraspinal extravasation as the cause. If pain and febrile symptoms occur at a later period, followed by the interrupted nervous function, inflammation of the membranes or of the cord itself is indicated. In this case, however, the interruption of the nervous power takes place more gradually than in the former, and is generally preceded by fever, hyperæsthesia, and painful cramps or startings of the limbs. The general constitutional disturbance also is more marked, so that, besides the period of accession, the symptoms of the two conditions of extravasation and inflammation are sufficiently diagnostic. In some instances, concussion of the spine may be followed by chronic forms of diseased action, affecting the medulla spinalis and its membranes, leading to gradually increasing paralytic symptoms. The progress of the alteration is very gradual, and so insidious as not at first to attract much attention; indeed, at first, the symptoms are mainly subjective, and so anomalous as often to be very similar to those of hypochondriasis or hysteria. If, however, any serious change in structure is commencing, certain marked symptoms supervene. The patient complains of a constant feeling of tightness and fulness at the lower part of the abdomen, and of slowness in passing urine. These symptoms he probably attributes to flatulence, which is generally present, and stricture of the urethra. Next, he feels peculiar creeping sensation (formication), pricking and numbness in the extremities. He has cramps and jerking of the limbs when asleep, or about to fall asleep, and in some cases there is hyperæsthesia of the skin, especially in the lower limbs. After a time the patient walks awkwardly, sets down his feet irregularly, and lifts them high from the ground, and unless he is looking at his feet he is apt to stumble, or catch the point of his foot against

slight inequalities. If we examine the patient at this time and desire him to shut his eyes and stand upright, away from any support, he begins to sway, and may even fall or stumble, and pressure on the injured part produces pain and starting of the limbs. After a time the paralytic condition becomes more marked, and the temperature of the affected limb or limbs is below the natural standard of the body. At this time the pulse and general constitution are affected, and the objective as well as subjective symptoms confirm the diagnosis.

I have said that even injury done to the ligamentous textures of the spinal column may be followed by such chronic changes as just described, in consequence of their close relation to and vascular connections with the membranes of the spinal cord, and a good deal has been made of this in regard to railway injuries; but it does not follow that, because it *may* happen *occasionally*, that *it is likely* to happen as a *general rule*. If ordinary care and treatment be adopted, such results will be the rare exceptions, and when the symptoms do arise we can test how far they are really indicative of structural changes or due to an over-excited apprehension, a species of hysteria. We examine the urine whether it be alkaline or contain much phosphatic deposit,—note the temperature of the affected limb or limbs in relation to the natural standard and that of the rest of the body, the movements of the patient, and the state of the muscular tissue as to bulk and contractile power; and thus, by careful personal examination, and using these and other tests, we can form a correct opinion as to the state of the patient in any given case.

I have already indicated the treatment to be adopted in the case of spinal concussion, and that required to obviate the increase of intraspinal extravasation and inflammation following concussion. The slow alterations in structure are not so amenable to treatment, because, from the insidious manner in which they manifest themselves, before the patient becomes alarmed, considerable changes and degeneration in structure have probably taken place. The remedial measures consist of abstraction of blood by means of leeches, or cupping over the part with a view

to relieve local congestion, in cases where the state of the pulse, febrile excitement, and painful jerkings of the limbs are present. In more chronic cases, counter-irritation by blisters, the actual cautery or other form of issue is indicated, and in all cases absolute rest is essential, if possible, in the prone position, or the patient lying on his side rather than on his back. The constitutional treatment must be carried out on general principles, according to the state of the patient, and great attention must be paid to the condition of the urine, as there is always a tendency in it to become alkaline, and easily decomposed. Chronic cystitis is almost uniformly present in the later stages. The condition of the bowels also requires great attention. In some chronic cases I have seen benefit derived from the exhibition of minute doses of strychnine. I generally prescribe it in solution, with the addition of dilute nitric acid, beginning with the $\frac{1}{16}$ th of a grain twice a-day, never exceeding the $\frac{1}{2}$ of a grain, and carefully watching its effects. By this treatment, and the use of the warm or tepid douche, and friction with the hand and hair glove, the patients sometimes recover some amount of power. In some chronic cases marked benefit is derived from the use of baths, such as those of Wilbad, Toeplitz, Gastein or Buxton. But in general these chronic affections, resulting from injury, are not satisfactory in their results.

FRACTURES AND DISLOCATIONS OF THE SPINE are, as you may readily conceive after what I have said regarding concussion, injuries in which the prognosis is always unfavourable, owing to the immediate and direct damage inflicted on the spinal cord by the fractured or displaced bones. Yet we sometimes meet with cases in which there is well-marked displacement or fracture, but where, from the manner in which the symptoms of paralysis pass away whilst the displacement of the bones remains unaltered, it is pretty evident that they were the effects of concussion, and not caused by the direct pressure of the displaced bone. (See case of John S—s in Clinical Cases.) The occasional occurrence of distinct fracture, and displacement of the vertebræ,

with little or only temporary disturbance of the functions of the spinal cord, may be accounted for by the flattened form and small size of the cord in relation to the cavity of the canal in which it lies. As a general rule, however, fracture or dislocation of the vertebræ is attended with complete or almost complete paralysis of the parts supplied by that part of the cord which is below the point of compression. Indeed, in most cases, from the secondary effects of the injury, diseased action, acute or chronic, affects the parts of the cord higher up, and so the loss of nervous power extends until at last complete paralysis takes place. If the injury be high up in the neck, death may result instantaneously, or the patient soon dies from interrupted respiration, depending on paralysis of the phrenic, thoracic, and intercostal nerves, or from the effect of the lesion being propagated to the medulla oblongata. In cases where the injury is lower down, the fatal result is less rapid, and the patient dies, exhausted by low febrile action, cystitis, and bed sores, or from extension upwards of diseased action and degeneration of the medulla spinalis, the paralysis gradually extending, as already mentioned. In some cases, however, when the patient gets over the first effects of the injury, the symptoms improve, and although some deformity remains, he gradually recovers, and the paralytic symptoms disappear. These successful cases should encourage us to use means, and not give up treatment as unavailing.

The *Treatment* to be adopted is similar to that for spinal concussion, only in most cases we require to place the patient on the back, and then the water-couch is almost essential to success. Attempts at reduction of the displaced bones are useless and dangerous, as being more likely to cause further injury to the cord than to replace the bones. Almost all displacements of the vertebræ are attended with fracture, as the short and strong connecting ligaments do not readily permit of luxation, without fracture. It sometimes happens, however, that fracture of the spinous processes and laminæ of one or more vertebræ

may occur without displacement of their bodies in consequence of direct injury.

It has been proposed that in fracture or displacement of the vertebræ, giving rise to compression of the spinal cord, we should apply the trephine so as to remove the compressing cause ; but as Mr. Liston has well observed, "the spinal cord is generally displaced and compressed by the lower portion of the fractured body of the bones. One cannot easily comprehend what an operation is to effect in such cases." From my own observation of the state of the spinal marrow in fatal cases, I feel satisfied

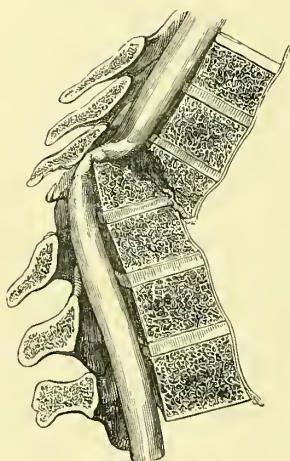


Fig. 7.

that in almost every instance the cord is not merely compressed, but its substance torn through or reduced to a pulp at the point of compression ; and therefore, as its structure and functions are thus destroyed at the moment of the injury, removal of the compressing bone could not restore them. The only case in which the operation of trephining could possibly be of service, would be to elevate the broken fragments in a depressed fracture of the spinous processes and laminæ of the vertebræ. But I would

not expect much benefit from the operation, and would not recommend or perform it. The patient will have a better chance of recovery by the treatment already advised, than if we add a fresh lesion and source of irritation to the existing injury.

Having now discussed the injuries of the scalp and cranium, it remains for me to speak very briefly of the diseases of that region. These are—tumours of the scalp, or those arising from the cranial bones ; cirroid aneurism of the vessels of the scalp ; nævi, or vascular erectile tumours ; and cario-necrosis of the cranium.

TUMOURS OF THE SCALP are generally of the benign class, and the different forms of encysted tumour are by far the most com-

monly met with. The general characters of their growth I have formerly described. In this region they usually exist in numbers, scattered over the head, and varying in bulk from the size of a barley-corn to that of an orange. The cysts are thick and distinct from the scalp-texture, and so loosely connected that they are readily pulled out, unless pressure or wrong treatment has caused inflammatory adhesions between them and the surrounding tissues. If not interfered with, they may attain a large size, but if they inflame and suppurate, or give way, unhealthy action takes place, the scalp becomes thickened and irritable, the cyst of the tumour throws out fungous projections, and exudes a horribly foetid discharge, and the lymphatic glands at the back of the neck and ears become painful and enlarged. Altogether the case assumes an appearance of malignancy, and these cases are frequently spoken of as degeneration of a simple into a malignant growth. There is, however, no true malignancy. The tumour becomes irritable, and degenerates locally, but if the original tumour was a simple encysted one, there will be no constitutional taint, nor any contra-indication to its removal ; and so soon as that is done, the enlarged lymphatics will disappear, and the wound heal and leave a healthy cicatrix.

The *Treatment* of encysted tumors in the scalp is in general very simple. If the growth is not larger than a small walnut, we transfix its base with a long narrow bistoury, and cut out, dividing the cyst and scalp, and then seizing the cyst with a pair of dissecting forceps, draw it from its loose cellular connections. In larger cysts, when we require to remove a portion of skin, or when we want to avoid opening the cyst, to prevent its contents getting amongst the hair, we may cut upon the tumour, expose the cyst, and turn it out whole, with very great ease. In cases where the tumour has suppurated, the cyst may be partly adherent, and at other parts very friable, so that we cannot remove it as a whole. Then we remove as much as we can with the dissecting forceps, clear away the contents, and touch any adherent portions with nitrate of silver or other caustic, and apply warm-water dressing. In cases where we have removed the cyst entire in the usual

way, we apply a compress over the part for a few hours, to prevent any blood distending the cavity in which the tumour lay. Afterwards, little or no dressing or other treatment is required. I have said that we usually find a number of encysted tumours existing in different parts of the scalp. In some cases I have removed as many as ten or twelve at once, but I think it better to avoid removing so many at one operation, as a number of small wounds over the scalp may excite undue irritation, and I therefore seldom remove more than four or five of the larger growths at a time.

We sometimes meet with tumours which simulate cysts, but are of a very different nature, soft solid growths, medullary or medullary fibro-plastic. These should be recognised by the rapidity of their development, the general appearance of the patient, and the suspicious circumstance—in this region—that there is only one tumour. The treatment is early excision, before the lymphatics are affected. Some years ago I removed a soft medullary tumour, the size of a small orange, from the scalp of an old woman eighty-five years of age, who insisted on its removal, owing to the pain and rapid growth. Notwithstanding her age, she made a good recovery. I saw her at different times for three years, during which time there was no recurrence of the growth, and so far as I know she may be alive yet.

Occasionally *SOFT MALIGNANT TUMOURS* of the cranial bones involving the scalp occur, and have, in their early stages, been unfortunately mistaken for wens. Operative interference in such cases is most disastrous in its results, for it hastens the progress of the growth, the removal of which is of course impossible. A less dangerous error I have known to be committed, is mistaking the swelling caused by a small eburnated exostosis for a cyst. Such exostoses occur mostly in the frontal region, and between the bony growth and the scalp or skin there is usually a sort of bursal cyst. If this be opened, and attempts made to remove it, a very disagreeable and dangerous form of erysipelas is set up, and this risk to the patient might be avoided by a little care in exa-

mining into the history of the case, and the character of the swelling.

VASCULAR ERECTILE TUMOURS or *nævi* are frequently met with, especially in children, both in the flattened and prominent form. The different methods of treating such growths have been already fully discussed. I may, however, state, that recently I have resorted very generally to galvano-puncture, the continuous current being used, and have found it very effectual, without producing any undue irritation. Whatever procedure is adopted, I would give you this caution, that if the *nævus* be over or close to the fontanelle, we should allow that opening to be closed before resorting to any interference in young infants.

The condition termed CIRROID ANEURISM, or ARTERIAL VARIX, consists in a dilated and tortuous state of the arteries, which form pouches, anastomose with, and lead to enlargement of, the communicating vessels. It is most frequently met with in the lateral regions of the scalp, and over the temples, affecting the branches of the temporal, occipital, or posterior auris arteries, and gives rise to a large pulsating tumour, on which the tortuous trunks of the vessels are seen. Pressure has occasionally been employed with success, to cause obliteration of the vessels. Deligation or compression of the trunks of the temporal or other affected arteries before they enter the tumour, has been the plan hitherto most resorted to. But in some cases of this disease in which galvano-puncture has been methodically applied, the results have been so successful that I think it will probably be found to supersede other measures; or it may be combined with acupressure, to hasten the cure and prevent all risk of embolism from displacement of portions of the clot. In all such cases where galvano-puncture is used, pressure with the finger is maintained on the main trunks during the application, until consolidation of the clot has taken place.

NECROSIS, or CARIO-NECROSIS, with exfoliation of the cranial

bones, has been already treated of as resulting from injury, or caused by specific forms of disease, such as syphilis or struma, or the effects of mercury. I need not therefore enter on the subject here, further than to point out that whilst the general rule in cases of necrosis—viz. to wait for the natural vital separation of exfoliations before attempting their removal—is applicable here as in other situations ; yet, from the proximity of the diseased bone to the membranes of the brain, cases do occur in which, in consequence of cerebral irritation, it becomes necessary to interfere to remove the diseased bone earlier in order to get rid of an obvious source of irritation, and prevent the accumulation of purulent matter. Again, in many cases of cranial exfoliations, it will be found that vital separation has really taken place, but the flattened surfaces adhere, and are retained by atmospheric pressure, and that on elevating one edge, the whole exfoliation comes away with perfect ease. As to other local treatment, it consists in the application of red oxide of mercury, or dilute nitric acid, together with the use of charcoal poultices, to destroy any remaining vitality in the exfoliation, and hasten its separation from the healthier parts, followed by weak solutions of carbolic acid, or of the chlorides of zinc or soda, as lotions to correct the fœtor and promote a gently stimulating effect on the surrounding tissues.

CLINICAL CASES.

CASES ILLUSTRATING INJURIES OF THE SCALP.

1. Anne G——, æt. 48, was knocked down a flight of stairs, whereby the whole frontal bone was laid bare, and the flap, divided into two equal portions, reflected over the face. Silver sutures were used to keep the parts *in situ* after the bleeding vessels were secured. The hair was cut short. Cold applications to head, and the patient kept on low diet. Afterwards, abscesses formed in both eyelids, and bare bone could be felt through the openings which were made to evacuate the pus. The parts, however, cicatrised without any exfoliation taking place, and no other untoward symptom occurred to delay the cure.

2. Henry C—g, æt. 9, fell among some stones from a height of 12 feet, causing a wound near vertex, four inches long. Lips of wound brought together by two silver sutures, hair cut short, and cold to head. Patient was pale, cold, and trembling, on admission, but perfectly conscious. Pulse 80. Next day he became very feverish, complaining of pain in head. Stitches removed, purgatives administered, and two leeches behind ear. Four days after admission, face was slightly erythematous. Cotton wadding applied, with the internal use of Tinct. Mur. Ferri. With rest, low diet, and occasional purgatives, the cure was completed on the twentieth day.

3. David C., admitted 23d December. While in a state of intoxication he fell from the top of a loaded cart, and received a severe wound of the scalp. The incision extended from the left frontal eminence to the middle of the occiput. The scalp was detached from its connections, and turned down over the ear, leaving a considerable surface of bone exposed. A stream of tepid water was directed over the wound, to wash away the mud and filth. The edges were then brought into accurate apposition by silver sutures; the head was shaved, the bowels freely opened, and low diet enforced. Although this patient was an old man and a habitual drunkard, he recovered without an unfavourable symptom.

4. David Williamson, æt. 60, fell from a locomotive thrashing-machine, the wheel of which passed over his head. On admission, twenty-four hours after the accident, the scalp and pericranium were found to be detached from nearly the whole of left side of head, and the bone was extensively fissured. Pulse 74, and of good strength. Head was shaved, poultices applied over the whole of left side, and an enema administered. Slight head symptoms, which yielded to leeches behind the ears and an occasional blister. Two large sequestra separated seven weeks after admission; the wound then rapidly healed, and the patient left, cured.

Commentary.—The foregoing brief notices of the results of different forms of severe scalp wounds are given to illustrate the

principles inculcated in the Lecture on that subject. Success in the treatment of scalp wounds depends greatly on their proper management at first. The wound ought to be carefully cleared of all filth by a stream of tepid water, the hair around it shaved, cold constantly applied to the head, the patient kept quiet in bed, put on low diet, and the bowels freely moved. If the skin has been reflected, it ought to be brought into position by points of silver suture. Sutures have been objected to as tending to produce great irritation, and the objectors either prefer compress and bandage, or leave nature to bring the parts into their proper site. Bad results will not arise from the use of silver, or even of thread sutures, if they are withdrawn on the first signs of irritation ; whereas the employment of a compress and bandage implies the collection of the discharge, the frequent change of the dressing, and the infliction of a considerable amount of daily pain and mental excitement. Again, if the scalp is allowed to hang down, it becomes thickened and everted, the process of contraction is tedious, and the uncovered bone is very liable to exfoliate. The cases narrated were treated in accordance with the principles above laid down ; and although the wounds were most extensive, the bone laid bare, and extensively fissured in some cases, and though one patient was an old drunkard, they went on most favourably.

CASES ILLUSTRATIVE OF PASSIVE INTRACRANIAL HÆMORRHAGE FOLLOWING CONCUSSION.

1. Mr. R. —, aged 24, fell from the back of a carriage whilst it was in rapid motion. He felt stunned for a few minutes, but recovered, was able to take a glass of water, and thereafter proceeded in the carriage to town. He felt, he said, quite well, but as his head was cut, he requested to be left at a friend's house that night, so as not to alarm his own family, and he walked without any difficulty to the house, some distance from where the carriage stopped. Next morning he awoke with a violent headache, and complained of noise in the head, but after a short time he again felt better. I was asked to see him, and visited him on the third day after the accident. He told me he had another attack of headache, accompanied with the same sensation of a "rushing noise" in the head, as on the morning after the accident. Of the fall, he spoke as having been

slight, and that he never had been unconscious, only stunned. At the time of my visit he felt little or no uneasiness in the head ; his pulse (usually 76) was 70, and soft ; he had taken some saline medicine, which had acted freely on his bowels, and he made light of his injury. The only disagreeable feeling he now had, he said, was occasional black spots before his eyes, which he attributed to indigestion. I ordered that eight leeches should be applied behind the ears, cold to the head, and enjoined absolute rest. I also prescribed a solution of tartarised antimony (1-16th of a grain) every fourth hour.

Next day he was much better, had had no return of the headache ; felt lighter, as he expressed it, and wanted to get up and go home. I, however, persuaded him to remain quiet, and continue the treatment and antiphlogistic regimen ; his pulse at this time never rose above 70, and was soft in character. He continued to go on favourably for the next six days, only very desirous to get up and go out. On the sixth day after the accident, as both he and his friends were urgent to have him removed home, I had him carefully removed in a carriage, with as little motion as possible. Notwithstanding every precaution, however, and though the distance he had to be conveyed was not great, violent headache, with the same rushing sensation in the head, occurred during the transit, and continued when he was placed in bed. After he had rested for some time, I felt his pulse, and found it was barely 60 beats per minute, and laboured. I at once ordered twelve leeches to be applied behind the ears, and cold cloths constantly kept to his head, and hot bottles to his feet. Under this treatment the headache and uneasy feeling and noise in the head passed off, and he again felt well. The pulse, however, never rose above 60, and the pupils contracted sluggishly ; in other respects, he said he felt quite well, and two days afterwards he was anxious to be up, and could hardly be persuaded to remain in bed. On the eleventh day from the accident, he did not feel so well, complained of aching pain, and return of the sensation of rushing noise in his head. He had a somewhat anxious expression, though, at the period of my visit, the pain in the head had passed off ; his pulse had now fallen to 56, and his pupils contracted very sluggishly. In the evening he was flushed and excited, but the pulse was still slow. He passed a very restless night, starting, and speaking through his sleep. He had a dose of henbane, which quieted him and procured him some sleep. Next morning he looked pale and haggard, and though still excited in manner, his pulse was 54 and laboured, his pupils largely dilated and sluggish in contraction when tested by the light of a taper. I ordered a blister to the nape of the neck, and an enema to act on the bowels ; and as he was restless, with a tendency to wandering and delirium, he was constantly watched. Throughout the day he was quieter, and said he was free from pain. In the evening, I found him again flushed and excited, and complaining of pain, but his expressions were incoherent. I remained with him for some hours during the first part of the night ; about midnight he became delirious and somewhat violent, but recognised me and lay quiet when I spoke to him ; by and by he fell asleep, and I left him. All next day he continued in a delirious state, but seemed relieved by the action of the blister. I again watched with him during the evening, and as he seemed quieter and inclined to sleep, I left about midnight. At 4 A.M. I

was summoned to see him. He had awoke about 2 A.M., as from a dream, in a state of violent delirium, and tried to get out of bed, when, in an attempt to do so, he suddenly became convulsed and unconscious. When I reached his house he had so far recovered consciousness, but was incoherent and restless. His features were distorted as from paralysis, and there was strabismus; his pulse was about 50. Cold was applied to the head, and flannels, wrung out of warm water in which mustard had been diffused, were wrapped round his feet and legs. He had passed his feces and urine involuntarily during the convulsion. After a time he became quieter, but I remained in the house. In the morning he had another slight convulsion, after which he passed into a state of profound coma, with stertorous breathing, dilated pupils, and all the other symptoms of compression of the brain. He died on the morning of the fifteenth day after the accident. The *post-mortem* examination revealed an enormous mass of blood effused over the left hemisphere of the brain, between the bone and dura mater, and also in the occipital region. The greater part of the coagulum was soft and recent, whilst other and smaller portions were of different degrees of solidity, some portions being very firm. The blood seemed to have escaped from the rupture of one of the small petrosal sinuses, where it entered the lateral sinus. There was no laceration or other lesion of the brain-substance, but there was considerable subarachnoid effusion of a plastic character.

2. Mr. —, aged 21. In driving a gig down a steep hill near Edinburgh, the horse ran off, and he was pitched out with great force, and was lifted up quite insensible and cold. He was brought into town, and I saw him on the forenoon of the next day. I was informed that the state of concussion had lasted for some hours, after which he became conscious. He then vomited, and complained of headache. When I visited him, reaction had set in; his skin was warm, his pulse 72, and he had only slight headache. I ordered the head to be shaved over the bruised part, and cold to be applied to the head, and an enema to be given. On my visit in the afternoon, I found that the bowels had acted freely after the enema; but he complained of a dull heavy headache, and a noise "like waves" in the head. On examining the pupils they were dilated, and only contracted very slowly under the stimulus of light. His pulse had fallen to 58 beats in the minute, and his breathing seemed oppressed. I at once bled him from the arm to the extent of 14 ounces. He expressed himself much relieved of the headache, and breathed more easily; and his pulse rose to 76 after the bleeding. I now had the whole head shaved, and iced water cloths constantly applied to his head. I ordered very minute doses of antimony every three hours, and enjoined absolute quietude and low diet. At my visit next day he was somewhat sick from the antimony, but had no headache or uneasiness. His pulse was 70. In the evening he had a slight headache, and his pulse had fallen to 66. I ordered four leeches to be applied behind the ear. In the morning he said the headache had been relieved by the leeches; but that shortly before I came, after getting up to stool, he felt the sounding in the head, and some pain. His pulse at this time was 70. I ordered the cold to the head to be continued, and warned him against getting out of bed on any account. In the afternoon his headache had increased, the pupils were dilated and sluggish, and

his pulse had fallen to 58. I again bled him from the arm to the extent of 10 ounces, and desired the cold and other treatment to be continued. From this time he went on favourably till the fourteenth day, when he had some return of the symptoms. These yielded, however, to the effects of a blister to the nape of the neck, and free purgation; and he left town quite recovered at the end of a month.

CASES OF INTRACRANIAL SUPPURATION.

1. Christina S—n, æt. 36, on the 28th January 1860, was struck on the head by a quantity of hard lime and brick thrown from a house-top, three storeys high. She was rendered insensible for some time, and lost a considerable quantity of blood from a wound, two inches long, situated over the middle of the superior part of os frontis. Admitted, February 7, 1860. Patient staggers as she walks; is dull and listless; complains of severe pain around wound, the edges of which are pale brown and everted; nearly two inches of frontal bone can be felt bare. Has had repeated rigors since third day after the accident; vomits continually; pupils dilated and sluggish; pulse 60. Ordered aperients, and blister behind ear. No improvement following this treatment, Mr. Spence trephined at the seat of the injury. Only a little matter was found; but immediately after the operation the pulse rose to 66, and vomiting only occurred once afterwards, while the rigors never returned. Headache continuing, a seton was introduced; and, on the 25th April 1860, the patient left, cured.

2. James B—r, æt. 28, fell on the 28th April 1860, and was admitted into the hospital 7th May 1860. Over occiput a scalp wound existed, whose edges were swollen, puffy, pale brown, and everted. The bone was entirely denuded of periosteum. He had headache, dimness of vision, and singing noises in the ears. Ordered rest, low diet, purgatives, and leeches. On the 13th an abscess below the wound was opened. On the evening of the 18th he was seized with rigors and vomiting. A blister applied to nape of neck, head to be shaved, and mustard cataplasms to epigastrium. The rigors and vomiting, with high pulse and occipital pain, continued unabated until the 19th, when delirium, and then coma, set in. Patient died on the 22d, at noon. His friends would not allow trephining to be performed.

Post-mortem.—May 24th. Membranes generally adherent. Beneath necrosed occiput a quantity of purulent matter was found. Dura mater at same place sloughy, but entire. From occiput a fissured fracture extended downwards, forwards, and upwards, terminating at the post-clinoid process. No pus was found between the membranes and brain, nor in the brain-substance itself.

Commentary.—The case of Christina S—n illustrates the amount of disturbance which may be caused by a very small amount of purulent matter, and dead or dying bone. Before her admission into hospital, ten days after the injury, she had had

intense headache, want of sleep, vomiting, and repeated rigors, and, for some days before admission, imperfect power of controlling the movements of her limbs. Notwithstanding all remedial measures used after she was received into the hospital, the bad symptoms increased. She screamed with pain ; at the same time a kind of semi-consciousness as to surrounding objects developed itself, and there was limited facial paralysis. The wound of the scalp was unhealthy, and scalp around boggy and swollen, whilst the exposed bone was dry and bare. Under these circumstances trepan was performed ; and although only a very little unhealthy pus was found, yet her recovery went on without interruption from the time of the operation. I cannot help concluding that removal of the dead bone and small quantity of pus, as sources of irritation, and the relief of tension, proved the means of saving this woman's life, judging from the progress of the symptoms prior and subsequent to the operation.

In the case of B—r, though the dangerous symptoms were somewhat slow in manifesting themselves, yet the unhealthy state of the scalp wound, and the denuded bone, in conjunction with headaches, gave rise to an unfavourable prognosis ; and when the more urgent symptoms supervened, combined with the formation of a boggy swelling which, when opened, exposed a farther portion of bare bone, I felt no hesitation in recommending trephining. This, however, was not permitted, and the patient died comatose. From the *post-mortem* appearances, I still think that the operation was advisable, as affording a chance of relief. The existence of the fissure of the base could not be determined during life ; and, moreover, as it was attended with no displacement, and as the only place where the dura mater was diseased was at the point corresponding to the puffy swelling and necrosed bone, I cannot consider such fissure as in itself a contra-indication, especially if we view it in connection with the successful result of some other cases of severe fracture at the base which I have recorded.

CASE OF FRACTURE OF THE CRANIUM.

Arthur M'Kenzie fell from a ladder whilst at work, and alighted on his head. He was taken up insensible, and immediately brought to the hospital. He was in a state of complete collapse—face pale, extremities cold, pulse scarcely perceptible. A large fluctuating tumour was observed over the left parietal bone, and a sharp raised margin felt at some parts of the circumference of the tumour. Head was shaved, heat applied to the surface of the body, and a little brandy administered. Towards evening the pulse rose to 100, and was stronger; breathing long, loud, but not stertorous; pupils dilated, and insensible to light; patient once or twice spoke, and complained of pain. Six leeches were applied behind the ears, and cold to the head. Under the repeated application of leeches, and the use of free purgation, patient rapidly improved. Ten days after admission, as the pulse again rose, a seton was introduced at nape of neck. The tumour now began to disappear rapidly, and an evaporating lotion was applied. Severity of head symptoms soon abated. At the end of four weeks the depression could scarcely be detected, and at the end of two months the patient was dismissed cured.

CASES OF COMPOUND COMMINUTED FRACTURE OF THE CRANIUM.

1. J. H., plumber, was brought to the Infirmary at 3 P.M., August 1, having a short time before fallen from a considerable height in the National Bank. On admission he was nearly insensible, his skin cold, breathing low, and pulse 70, very feeble. There was a wound two inches long on the back part of the head, towards the left side, communicating with a depressed comminuted fracture of the skull. There was fracture of the right leg and of the middle metacarpal bone of the left hand, and a superficial wound on the left arm. He vomited considerably while being placed in bed. Hot bottles were applied all round his body.

At 4 P.M. Mr. Spence applied the trephine, and removed the depressed portion of bone. It was then observed that the dura matter was injured at one point, and the cerebral matter could be distinctly felt projecting. There was immediate improvement in the patient's condition. He became more sensible; his pulse rose to 80; his breathing became more natural; but his face was noticed to be twisted to the right side. Next day he complained of intense headache; his face was flushed; pulse 90. Six leeches were applied behind the left ear, and they were repeated in the evening, giving great relief.—On the 4th his pulse was still 90; headache present, but not so intense. Leeches were again applied.

On the 7th the wound began to suppurate, the pulse fell to 70, and the headache disappeared. From this time the patient progressed favourably, his cure being retarded by cynanche tonsillaris, from which he suffered severely during the last week of August. He is now quite well.

2. Thomas Porter, æt. 22, was kicked by a horse on the head, and

was immediately brought to the hospital, when there was found to be a scalp wound about half-an-inch in front of the posterior superior angle of the left parietal bone, three quarters of an inch to the left of the longitudinal sinus. On introduction of the finger, a considerable depression of bone was detected, a portion being driven in and impacted. His pulse was of a good strength, and up to that time he had suffered from no head symptoms. He was put under the influence of chloroform, and the operation for trephining resorted to. Several impacted portions of bone were removed; the dura mater was seemingly intact, except at one point. There was considerable venous hæmorrhage, which, however, soon ceased. One or two silver sutures introduced to keep flaps of skin in contact, the head shaved, and cold applied. On the following day his bowels were fully opened by means of jalap and calomel, and he was apparently going on favourably, till the evening of the fifth day, when his pulse rose from 85 to 140, and he began to complain of considerable pain in the head. Six leeches were applied behind the ears, and a saline aperient administered. Following day, feverish symptoms still continuing, a blister was applied to nape of neck. Pupils slightly dilated, but readily contract on application of light. On the seventh day there was a distinct rigor; wound looking healthy. Complained of complete loss of power of the right side on the ninth day. Head symptoms more intense; ordered small doses of calomel: portion of dura mater now began to look sloughy; patient became rapidly worse; pulse ranging from 130 to 140; answered questions incoherently; was very violent at times; breathing stertorous; and died comatose on the thirteenth day.

Post-mortem appearance.—Dura mater sloughy at parts; pus effused over the surface of the brain, and an abscess at base of brain on left side.

3. J. T., while following a runaway horse, received a kick on the forehead. He had been drinking previously to the accident, and when admitted to the hospital, half-an-hour afterwards, was in a somewhat excited state, and his pupils were dilated. There was a compound fracture, with depression a little above the right superciliary ridge. Mr. Spence, being sent for, immediately trephined, and found much splintering of the inner table, with slight abrasion of the dura matter. The head was ordered to be shaved and cold applied, while low diet and perfect quietness were enjoined. For six days after the operation the patient progressed most favourably. The wound looked well; there was no headache or flushing of the face, and his pulse averaged 72. On the 7th day, after a restless night, his pulse rose to 86. He was ordered six leeches behind the ears, antimony in doses of a twentieth of a grain, and a saline aperient. Feverish symptoms continued to increase in severity during the two following days. He complained of intense headache; his pupils were dilated, and there was a wild expression of countenance, with slight delirium. On the tenth day, the pulse fell to 40, and, after several violent convulsive seizures, he died comatose. After death there was found to be pus infiltrated into the meshes of the pia mater all over the surface of the brain.

4. A—P—, aged 17, residing at Walltower, near Penicuik. Whilst engaged with some of his fellow-workmen at a game of quoits, he stepped forward to mark the position of the quoits, thinking all had been thrown. Just as he was stooping he was struck on the left side of the head; he

felt the blow and was stunned, but not rendered insensible. He was conveyed home, and seen by Dr. Fanchie, who found he had suffered a compound fracture of the cranium. I was sent for, and saw the patient a few hours after the accident. He was then in bed, conscious but restless, moaning, and suffering from pain in the head. His pulse was slow and full, pupils were dilated, but contracted slowly under the stimulus of light. On examination I found a large scalp wound with depressed and somewhat ragged margins: on raising these, and introducing my finger, I felt that the left parietal bone, about two inches above the squamous suture, was fractured, comminuted, and depressed, and a portion driven inwards and downwards under the lower edge of the fracture. I accordingly, after bringing the patient under the influence of chloroform, proceeded to apply the trephine, which enabled me to remove many fragments; but the large shelving portion was so impacted that I removed a projecting corner of bone with Hey's saw to gain room, so as to avoid risk to the dura mater in extracting it. I then lifted it out easily, and also several other smaller portions which were then exposed. The dura mater had been shaken from the bone for some distance, but so far as I could see or feel that membrane seemed to have escaped laceration or puncture. The wound was then dressed, and the patient replaced in bed. From the time of the operation he went on so favourably that I did not require to see him, and he was allowed to go out at the end of six weeks. The operation was performed in September 1868, and when I saw him last, in August 1870, he said he had never suffered any inconvenience, and that he could follow his business, that of a joiner, which requires him to ascend considerable elevations, without any giddiness. The opening left by the injury and trephine wound, which was large, had apparently filled up almost, if not altogether, by a thin firm osseous plate, a result which is unusual in my experience of such cases.

COMPOUND COMMINUTED FRACTURE OF CRANIUM, WITH WOUND OF THE LONGITUDINAL SINUS.

G. B., a young, stout, and healthy cabman, was admitted on the 29th January. When standing on the pavement of the High Street a brick fell from the roof of a house, and inflicted a very severe compound comminuted fracture of the cranium. By the injury he was rendered a little giddy, but not insensible. On admission, the general symptoms were far from being alarming; the pulse was 72, and natural; the pupils equal and contractile; the skin warm; and the respiration normal. The fracture was situated over the posterior extremity of the sagittal suture, and extended about an inch transversely and longitudinally. It was accompanied with marked central depression. There had been a slight amount of hæmorrhage, but it had almost entirely ceased. Chloroform was administered, and the incision in the scalp extended. A small fragment of bone, which was completely detached, was removed, and the bone-pliers were introduced through the opening, so as to divide the denuded and depressed pieces, and allow of their being either elevated or withdrawn. The inner plate was found to have been splintered. The smaller frag-

ments were easily taken away ; but one large, shelving portion had to be divided by the pliers previous to removal. As this latter spicula had been driven into the longitudinal sinus, a gush of blood followed its withdrawal. The jet was easily checked by the pressure of a finger until the wound was thoroughly searched, and all loose particles removed. A small piece of lint was then placed directly over the wound in the sinus, and above it larger pieces, until the whole space was lightly filled. This sufficed to check the hæmorrhage. The patient was replaced in bed, and iced water kept constantly applied to the head. Next day all the pads were removed except the one in direct contact with the blood-vessel. In the evening a saline purge was given ; and as the pulse had risen from 84 to 100, he was put on small doses of tartar-emetic. On the third day a small fragment of bone, which pressed directly inwards on the brain, was removed by the pliers. During the third and fourth days, the pulse varied from 80 to 88 ; the mental faculties were unaffected ; and the general appearance of the patient augured well. On the sixth day, however, he had slight rigors, and the pulse rose to 112. Leeches were placed behind the ears ; and on the seventh day the pulse numbered 92. In consequence of the pulse rising to 100 towards evening, a blister was applied between the shoulders. On the morning of the eighth day he wandered, the rigors and sweats were repeated ; in the afternoon he became comatose, with paralysis of the left arm and leg, and marked dilatation of the pupils. The coma gradually deepened, and he died on the evening of the ninth day after receipt of the injury. On examination, the bone around the wound was smooth and healthy, but underneath the dura mater a diffuse collection of pus covered the right side and base of the brain. A small abscess was found in the posterior lobe. The longitudinal sinus was completely occluded by a large fibrinous clot.

GUNSHOT FRACTURE OF CRANIUM.

A. B., æt. 21, was brought to the hospital on October 2d, at 9.30 P.M., with a severe compound comminuted fracture of the skull, which had been caused by the discharge of a fowling-piece. The fracture involved the left parietal and frontal bones, and was situated about midway between the anterior termination of the sagittal suture and the anterior inferior angle of the parietal bone. The wound of the integuments was much lacerated, and several pieces of the splintered bone were depressed. Mr. Spence, who was at once summoned to the case, removed in all fifteen detached fragments of bone, and elevated any remaining portions which were depressed. The dura mater was found intact, except at one point where there was a small laceration. The patient, who was now placed in bed, after having had his head shaved and cold applied, seemed to be in some degree conscious of what was going on, and to understand questions addressed to him, though unable to answer them. The pulse, which, though weak, was about the natural standard after the operation, about three o'clock next morning became strong and full, and rose to 88 ; and as the patient was feverish and restless, he was ordered antimony in doses of a twentieth of a grain. During the day he vomited twice ; the pulse

varied from 80 to 54. He was ordered six leeches behind the left ear, and an enema, which moved his bowels freely. On the morning of the 4th, after a tolerably quiet night, the wound was looking well, but the pulse, which was about 66, was irregular, and there was slight paralysis of the right side. On the evening of the 5th, six leeches were again ordered to be applied to the mastoid region, in consequence of the pulse having fallen to about 50. 6th.—Pulse 60; urine, hitherto passed in bed, drawn off by a catheter; ordered a castor-oil enema. 7th.—Patient has passed a good night, and seems more intelligent, but is still unable to make water. Convulsions, however, came on in the afternoon, chiefly affecting the paralysed side, and there was considerable hæmorrhage from the wound, through which the brain-substance had begun to protrude. 8th.—Has had two more convulsive seizures; pulse 67, regular; blister ordered to the nape of the neck. About 3 P.M. there was renewed hæmorrhage from the wound, which was arrested by transfixing the bleeding point and securing it by a ligature; pulse 86, regular, but weak and compressible. 9th.—Hæmorrhage again occurred, and could not be staunched till a slough had been removed. 12th.—For the last two days the fungus cerebri has been rapidly increasing, and is now about the size of the closed fist. Patient somewhat restless, but intelligence still improving; has passed water voluntarily for the last three days; pulse 100. 15th.—Since last report the patient has been progressing favourably, but to-day he has had repeated rigors, and been very restless and noisy. Part of the fungus has separated; the bowels have been freely moved by an enema; pulse 106. 16th.—Patient looks much worse; has passed a very bad night. Recurring hæmorrhage from the surface of the fungus, and edges of the wound, arrested by matico; pulse 100. Early next morning symptoms of coma gradually set in, and patient died about 4 A.M. On post-mortem examination, an abscess was found diffused through the left cerebral hemisphere, the surface of which was covered with a layer of pus most distinct towards the base.

Remarks.—The case of Arthur M'Kenzie was one of simple fracture of the cranium, with depression; but the dangerous symptoms were evidently those of severe concussion, not compression. The depression of the cranium was pretty extensive as to surface, but not in depth; and the state of the pulse, pupils, and breathing, as well as the subsequent progress of the case, showed that the symptoms were not due to the depression of the bone. I think it well to notice this, as there is often a tendency, when such injury exists with symptoms of unconsciousness, to regard the fracture as the cause, and to resort to operative measures to remove the depression. This case, with many similar which I have seen, shows the necessity for carefully examining the general symptoms; and—if they be those of con-

cussion—of refraining from operative interference with the depressed bone, but resorting to other treatment. Indeed, even when the symptoms are those of compression, when the fracture is simple, I consider it the wisest plan not to interfere unless the symptoms do not yield to depletion, purging, and other general remedies ; for, in a great number of cases, such general treatment is successful.

The cases of compound fracture of the skull stand out in strong contrast to the last case, as regards the propriety, or rather the necessity, for operative interference. In cases of compound fractures, especially in such as those detailed, in which the injury has been inflicted by great and direct force, and where, through the wounded scalp, we can see or feel that the bone is depressed and comminuted, there can, in my opinion, be no possible reason for delaying the removal of the shattered fragments, and elevating the larger depressed portions. By operating here we superadd no danger. We do not convert a simple into a compound fracture, whilst we remove the detached spicular fragments, which, if they did not directly puncture the membranes, must ultimately, as foreign or dead portions, infallibly lead to inflammation and suppuration within the cranium. In such cases, to wait for urgent symptoms as our warrant to operate, is to wait till the operation is of little use. It was this conviction, founded on former experience, that led me at once to operate in the cases of Porter and J. T. Unfortunately, a sharp-pointed portion of the depressed bone had injured the dura mater, and this, I doubt not, led to the meningitis which proved fatal ; but the numerous detached fragments removed showed the absolute necessity for interference. The venous bleeding referred to in the report of Porter's case followed the removal of a shelving portion of the inner table which had been driven up towards the sagittal suture ; and I think there could be little doubt that the fragment must have punctured the longitudinal sinus, so that its withdrawal was followed by smart venous hæmorrhage, which, however, was soon stopped by very slight pressure.

The case of A. B. was one of very severe and extensive

compound comminuted gunshot fracture ; and when we consider the lacerated state of the scalp, and the extreme splintering of the skull, there can be little question of the propriety of removing the shattered and isolated fragments of bone. Even in the absence of any marked symptoms of compression, operative interference was not only justifiable but urgently called for, as the presence of broken pieces of bone, severed from all vital connection, would, by their irritation of the membranes and their certain necrosis, have undoubtedly been attended by greater risk to the patient. The paralysis, convulsions, and other nervous symptoms, together with the hernia cerebri which subsequently took place, cannot be considered as having been influenced by the operation, for they were no doubt due to sloughing of the membranes, and to inflammation and suppuration within the cranium, following the laceration of the dura mater and contusion of the brain-substance, which took place at the time of the accident. As in this case, true hernia cerebri seems always to be accompanied by abscess of the cerebral matter, and to be the result of increased volume due to the presence of the products of inflammation. Though there was great danger from the recurring hæmorrhage, death was caused not by the hernia cerebri, but by the morbid processes going on within the cranium, of which the hernia cerebri was the result.

CASES OF SIMPLE FRACTURES OF CRANIUM COMPLICATED WITH ACTIVE INTRACRANIAL HÆMORRHAGE.

1. R. M'D., æt. 40. Admitted February 15th, 1859, about 3 P.M.—Said to have been struck by a poker on the head, and pushed violently down stairs. He was seen by Mr. Dewar on admission, who described the symptoms under which the man laboured as being those of concussion. He was, however, nearly totally insensible ; the pulse quick and small ; the breathing very slow and gentle.

At 5 P.M. the patient was in a state of complete insensibility ; breathing slowly, but calmly, not stertorously ; pulse 68, full ; left pupil much contracted ; right pupil much dilated ; both insensible to light. On the left frontal region, about an inch above the eyebrow, was considerable ecchymosis, and a small punctured wound, into which a probe could be passed down to the pericranium. Over the parietal and part of the occi-

pital region of the left side, there was much ecchymosis of the scalp. About two inches above and behind the left ear, the finger could be placed in what seemed to be a depression of the skull, but no wound existed at this part.

At 8 P.M. his breathing had become somewhat stertorous, with slight puffing of the cheeks. Mr. Spence made a crucial incision at the part where the depression of the skull was supposed to exist; and on passing the finger down, a severe comminuted fracture was found, and a portion of the bone depressed nearly half-an-inch. The trephine was applied, and a full half-circle removed from the edge of the bone. The depressed portion was then elevated, and a triangular piece, which was lying loose, removed. There was little perceptible change made on the patient's appearance by the operation. He remained perfectly comatose; his pupils were widely dilated; his pulse immediately rose to 120; and he vomited slightly. He remained perfectly insensible till half-past 1 A.M. of the following morning, when he died.

Post-mortem examination revealed very extensive fracture of the skull, stretching from the point where the trephine had been applied through the squamous and petrous portions of the temporal bone to the foramen magnum on the right side. The right hemisphere of the brain was entirely covered by a thin layer of blood.

2. D. L., æt. 38, fell, on the 27th July, about 3.30 A.M., from a window into the street, alighting on his head. When admitted, immediately after the accident, he had a flushed face, was noisy, excited, and smelt strongly of spirits, but answered questions quite coherently. There was an extensive bruise over the right temporal region, where the patient complained of pain; there was great swelling and ecchymosis of the eyelids, especially the right. There was no external wound, and no depression of the skull. Slight vomiting, but no signs of compression. Pulse 96, and soft. The head was shaved and cold applied, and a cathartic enema was administered. Towards evening, as he was more restless and excited, and the pulse had risen to above 100, he was ordered to have three leeches behind each ear. About 5 o'clock on the following morning I was summoned to the patient, and found him violently convulsed, with a slow and irregular pulse and dilated pupils. In the intervals of the convulsions he was evidently comatose. I made an incision over the point where the patient had complained of pain, and where there was the greatest amount of extravasation, and, finding a fissure, immediately trephined. The inner table was found splintered at the edges of the fissure; there was some amount of blood between the bone and the dura mater, and the latter was tense and bulging, and, when divided, a considerable quantity of bloody serum escaped. The patient derived no relief from the operation; convulsions recurred in the course of the day; coma gradually became more profound; and he died in the evening at 10.30 P.M.

Remarks.—In the case of R. M'D., the question of operative procedure required to be very carefully considered. When I first saw the patient the symptoms of compression were of the most decided and urgent character; but then, from the effusion

of blood below the scalp, it was by no means easy to ascertain whether the depression felt was really a fracture, or the soft pitting in the centre of the hard clotted blood, while the history of the case, as one of concussion, gradually merging into compression after reaction, seemed to point to extravasated blood as the compressing cause; and the occasional convulsions and sub-sultus tendinum led me to suspect laceration of the cerebral substance. Still, as I felt pretty sure of the feeling of fracture, I determined to incise the scalp to make quite sure, and if I found one, to operate, as, though the other conditions might be present, still a depressed fracture would of itself be sufficient to cause compression, and its removal would give a chance for life. The incision revealed a largely comminuted and depressed fracture, the chief depression being very deep. Several pieces were removed, and the edges of the bone were elevated; there was no blood between the bone and dura mater. The result of the *post-mortem* examination proved the existence of the other lesions I had dreaded from the history of the case, and were sufficient to account for the fatal result. Still, the propriety of operating in such a case is obvious, as affording the patient a chance, should the depressed fracture be the principal lesion; whilst of course we can have no positive certainty as to the existence of other lesions, though we may prognosticate them from the symptoms.

The possibility of serious injury of the head remaining latent for a considerable time is well seen in the case of D. L., who, although he had sustained an extensive fracture of the skull, accompanied by laceration of the brain-substance, showed no marked cerebral symptoms for several hours after the accident. On admission, the patient was apparently suffering from slight concussion, which soon passed off, and no alarming symptoms manifested themselves until the following morning, when he was seized with convulsions and subsequent coma. The development of these symptoms, and the period of their occurrence, pointed to extravasation of blood as their cause; while the site of the external injury rendered it not improbable that

there was fracture of the skull, with rupture of some of the branches of the middle meningeal artery. The operation, though demanded in the circumstances, was followed by no improvement in the condition of the patient, who gradually died comatose. On post-mortem examination, the fissure was found to extend right across the base of the skull. The base of the brain was also found ruptured at several points, more especially at the line of fracture, and a layer of pus covered its entire surface. The occurrence of a distinct layer of pus over the surface of the brain at so early a period after the accident, is certainly remarkable, and may seem to justify a suspicion of the injury being merely a coincidence occurring in the course of an inflammatory action of the meninges. This, however, is rendered improbable, not only by the history of the case, but also by the facts that the pus was most abundant in the line of fracture and at points corresponding to the rupture of the brain-substance, and that the brain-substance itself at these points was undoubtedly the seat of inflammatory action, as proved by microscopic examination.

OPERATION OF TREPAN.

The following extract from a case narrated by Mr. John Bell affords so good an illustration of what I stated in my Lecture on Trepan as to the advantage of using the Hey's cranial saw in certain circumstances instead of the trephine, that I quote it here. Mr. Bell says—

“I made an incision into the tumour, a long incision, which, directed by what I felt without, uncovered a long fracture, the circumstances of which are represented in this sketch. One great fracture (*a*) running down the forehead, passed into the orbit, and was so very wide that it easily admitted the handle of my scalpel; the other limb of the fracture (*b*) ran round in the direction of the coronal suture; the whole piece and corner marked (*c*) was deeply depressed, and so far locked under the edge (*d*) that it was necessary to make those two perforations, and to cut off a small projecting corner with the finger-saw, before we could think of using the lever. The blood rolled out through the first perforation. The depression of the dura mater by the blood was as great as in the former case; the circle in which, I could with the probe feel it detached, was as wide. The rising of the pulse, which had been oppressed; the

recovery from the stupor ; the granulation of the dura mater, and the closing of the wound ; and the daily issue of clotted blood, make this, in all respects, a just parallel with the case I have just related. The extent of the wound was such, that the boy was not dismissed till the 9th of January, the 7th of September being the day of his fall. But what surprised and gratified me was this,—The piece of bone marked (c), which had been depressed and elevated, actually moved with each pulse of the brain, so loose did it lie upon the dura mater. I feared, when I saw the dura mater through the trepan holes, red and granulating ; when, on the twentieth day from that of the operation, I found also all the exposed parts of the skull covered with a fine and florid pile of granulations, this triangular piece of bone excepted (which continued yellow, quite bare, and still movable) ; that it must become entirely carious, and exfoliate ; and that this, by protracting the cure, or, by its exposing the brain, might bring the boy into new danger : I had this impression on the 30th of November, and marked it in my daily report ; but by the 6th of December the same pile of florid granulations had crept along over the whole surface of this portion of the skull, and by the 14th the whole wound was cicatrised.”

Mr. Bell states that when the triangular depressed portion was elevated after removal of a large portion of sound bone by means of two applications of the trephine and section of the intermediate portion with the small saw, he found it so loose that it rose and fell with every movement of the brain, and that he feared from the appearance that it would exfoliate. In his case it fortunately did not, but the chances were all against it retaining its vitality, and it seems to have retarded the cure. Now, by looking at the sketch in Plate xlv. Fig. 4, you will see that by applying the saw to the fissured base of the loose triangular portion, it could have been withdrawn from under the sound margin at *d*, where the trephine was applied, without any removal of the sound bone, and with the probability of a more rapid cure.

CASES OF FRACTURES OF THE BASE OF CRANIUM.

1. John G—n, æt. 39, while in a state of intoxication, fell down a flight of ten steps. He was quite insensible when admitted ; bleeding from both ears (especially the right) and nostrils ; breathing stertorous and slow. Pulse 60, weak ; pupils contracted and fixed. Cold to head and a dose of croton oil was administered. Next day was semi-conscious, drowsy, and complained of severe headache ; vomited violently. Ordered three leeches behind each ear. On fourth day, pain much less, pupils natural ; quite deaf, and saw double with left eye ; pulse 72. On the

sixth day a blister was applied to nape of neck, with good effects. On the thirteenth day all the above bad symptoms returned, along with facial paralysis on right side; leeches and purgatives ordered. A seton was afterwards introduced, rest and low diet being constantly enjoined; and on the forty-seventh day he left, cured.

2. Jane S—r, aged 4 years, was admitted into the Royal Infirmary during the session 1859-60, in consequence of her head having been crushed under a coping-stone, which fell on her, and which was so heavy that it required two men to lift it from off the child. When brought into the hospital she was quite unconscious, with oppressed pulse and stertorous breathing. There was profuse bleeding from the left ear and from the nostrils. Her eyeballs were protruded in a remarkable manner, and the conjunctivæ were ecchymosed, and the tissues of the orbit seemed distended with extravasated blood.

The only treatment which could be adopted was the external application of cold to the head, sinapisms to the epigastrium, and hot bottles to her feet. The coma was so complete that neither food nor internal medicine could be administered except by enemata. A drop of croton oil in mucilage was placed on the back part of her tongue, to act as a purgative. She remained completely insensible for three days, and then began gradually to regain consciousness, and to be able to take food; after which she rapidly improved, and left the hospital perfectly well on the fifteenth day, and continued to be brought, as an out-patient, at intervals, for some time. No bad after-symptoms supervened.

I merely advert to the successful results of these fractures of the base of the skull, as showing that we should not despair even of such cases; for, by carefully watching symptoms, and applying proper remedial measures, we may assist nature in the curative process. I would specially notice, as an example of this, the case of G—n, in which there was evidence of extensive fracture, with great bleeding from both ears and nose, injury of ethmoid, and subsequent fœtid discharge from that region. The most remarkable recovery, however, of fracture of the cranium, was that of the child whose head was fairly crushed by a large coping-stone (so heavy as to require two men to lift it from off the child). When brought into hospital her head seemed flattened; the cranial bones felt loose, as if broken up; and the eyeballs protruded. The child was completely insensible from compression, and remained so for nearly three days. At first, recovery seemed almost impossible; and the treatment was necessarily limited to the application of sinapisms to the epigastrium and feet, cold

cloths to the head, and enemata ; yet, when she once began to rally, she recovered rapidly, and wonderfully little deformity of the head remained. On leaving the hospital she seemed quite lively and intelligent.

CASES OF INJURY OF THE SPINE.—(*From Clinical Reports,
Session 1859-60.*)

1. Patrick B—s, æt. 40, was doubled up and crushed by the weight of a horse falling on him, by which several dorsal vertebræ were fractured. Along with complete paraplegia, a low form of peritonitis set in, and he died on the fourth day.

2. John S—s, æt. 26, a strong muscular man, fell backwards over a rail seven feet high. Complete insensibility immediately followed the accident ; but on admission, an hour afterwards, consciousness was partially restored, with, however, all the symptoms of paraplegia, and involuntary emission of semen, urine, and fæces. A fracture was discovered at the sixth cervical vertebra. The patient was placed in bed, and the head and neck secured to a pillow. He gradually recovered the power of voluntary movement and sensation. On the twenty-fifth day he went out, and, two weeks after, resumed his employment as a brewer.

3. Peter K—r, æt. 38, during the delirium accompanying erysipelas of the head, jumped from the third storey of a house, whereby he sustained a fracture about the middle of the dorsal vertebræ. For the first ten days he had all the symptoms of paraplegia, requiring the constant use of the catheter. Urine phosphatic. Ordered Nitric Acid. As the bowels continued constipated, Ext. Nuc. Vomic., gr. 1, with Ext. Coloc., was administered thrice a-day. On the sixteenth day he passed his water without the use of an instrument. After this his appetite and strength gradually improved, and he only suffered from pain over seat of injury, for which a seton was introduced with benefit. Three months and a half after the accident occurred he walked perfectly, and still continues well.

Remarks.—The fractures of the vertebræ furnish us with two instances of successful results out of the three cases recorded. As a general rule, such success is unusual. The size of the spinal cord, and the nature of the osseous canal through which it passes, render it almost impossible that fracture, attended with any displacement, can occur, without such compression or injury of the cord as must lead, either primarily or secondarily, to interruption of its function, and consequent paralysis of the parts below the injury. Fractures, with displacement, occurring in the cervical region, may, especially from

the vital functions interrupted, be regarded as almost certainly fatal; yet, in the case of S—, we have an instance of such a lesion, with considerable displacement, terminating successfully. Judging from the train of symptoms observed, although the displacement and crepitus on movement left no doubt as to the nature of the injury, it nevertheless seems pretty clear, that the medulla spinalis must have escaped direct lesion; for the complete paralysis and other symptoms, at first urgent, gradually passed off, so that after some hours all the formidable symptoms had disappeared, and in a few days the patient felt so little uneasiness or inconvenience, that it was difficult to make him believe the serious nature of his injury, or get him to keep quiet in bed, and avoid moving his head. It is probable, therefore, that the original urgent symptoms were due either to severe concussion of the cord, or perhaps to a certain amount of direct compression without laceration, the compression being relieved when the patient was placed in bed, with the head supported. For my own part, I incline to the former view, and for this, among other reasons, that there never seemed to be any apparent alteration of the displaced bones, the shortening and bulging forward of the front of the neck, and the irregular depression and prominence felt posteriorly, being as marked, after the bad symptoms had passed off, as they were before. The interest of this case, however, does not terminate with the cure of the primary injury, for, contrary to my wish, he left the hospital on the twenty-fifth day after the accident, saying he felt quite well, and would be very careful of himself at home. I subsequently heard he had returned to his work; and on the 11th of March he applied to be re-admitted, on account of gradually increasing paralysis, which had rather suddenly supervened a few days before. The quick pulse and febrile condition of the patient, together with the difficult respiration and the paralysis affecting parts deriving their nervous supply from above the original seat of injury, led me to infer that secondary changes, the result of irritation and inflammation of the cord and its membranes, were taking place, if, indeed, softening had not actually occurred, and

gave me a most unfavourable opinion of the case. Under treatment, however, the bad symptoms again gradually disappeared, and he was finally dismissed cured.

The case, independent of other points of interest, is instructive, as encouraging to careful treatment even in cases all but hopeless, and as showing the necessity for enforcing absolute and prolonged rest and treatment, although the patient or his friends may consider all danger as past.

LECTURE XCVI.

Injuries of Face—Contusions—Wounds—Wounds implicating the Portio Dura—Wounds implicating the Parotid Duct, and leading to Salivary Fistula—Treatment of Salivary Fistula—Wounds of or near the Orbit—Ectropion—Ptosis—Removal of Eye—Extirpation of the whole Contents of Orbit—Obstruction of Nasal Duct—Fistula Lachrymalis : Bowman's Operation for its Prevention ; old Operation—Fracture of Bones of Nose—Foreign Bodies in Nostril—Epistaxis and its Treatment.

THE INJURIES OF THE FACE most commonly met with are, contusions, wounds, and fractures of the nasal and maxillary bones.

CONTUSIONS OF THE FACE, except when complicated with more serious injuries, seldom come under the care of the surgeon, as every one has some infallible method of cure in which he trusts. Occasionally advice is asked as to the speediest method of getting rid of the disfigurement caused by ecchymosis. If the patient apply immediately after the receipt of the injury, cold, assiduously applied, often prevents and always modifies the extent of the extravasation, and the discoloration arising from it ; but if the ecchymosis has taken place, then I know of nothing likely to be of much use except stimulating evaporating lotions to promote more rapid absorption. Time must do the rest. The aid of the artist is sometimes resorted to, but "the effect" is more remarkable than pleasing.

Owing to the great vitality of the textures, WOUNDS OF THE FACE generally heal by the first intention, unless prevented by some special cause. The direction and position of the wound are important. In cases of accidental wounds, causing injury to nerves or other structures, of course the mischief is done, and we can only, in certain cases, try to remedy it afterwards. But the

surgeon often requires to make wounds in this region in operating, and for their effects he is responsible. In planning his incisions, he must carefully consider the anatomy and functions of the parts which may be affected by his proceedings.

A wound made in certain directions may paralyse one side of the face completely, by dividing the trunk of the portio dura, and then the face is distorted, and the patient loses all expression on the injured side. If a surgeon made such a wound without its being absolutely necessary, he would commit a serious error. Any incision in the cheek should, as far as possible, be made more or less parallel to the main branch of the portio dura, and the trunk should never be cut across if it can possibly be avoided.

The same care must be taken in reference to the duct of the parotid gland ; but, as an accidental wound may implicate the duct, and give rise to SALIVARY FISTULA subsequently, we must consider how we can best prevent that condition taking place, or remedy it if it has occurred. In dealing with a wound of the face crossing the line of the duct, we must remember the anatomy of the parts. The duct runs from the ear across the cheek towards the nose, and opens into the mouth, nearly opposite the second molar tooth of the upper jaw. In a wound in this part, when we see that the duct is either cut or likely to be cut, the best treatment is to complete the incision into the mouth. Wounds which penetrate the cheek into the mouth are very seldom followed by salivary fistula, for the saliva naturally tends to pass into the mouth rather than outwards, and the direction and position of the duct favour this, if the external part of the wound be closed at once. If, however, the mucous membrane be not divided, a salivary fistula is often caused by the attempt to close the external wound over the wounded duct. The best plan, in such a case, is to complete the wound by dividing the mucous membrane, and then to close the external wound very carefully by silver sutures, whilst the internal wound is left open to allow the saliva to pass into the mouth. When a salivary fistula has become established, we

generally find a small opening with callous edges, and a slight trickling of the saliva over the face. This gives rise to a great deal of excoriation of the skin. Digestion also becomes impaired by the loss of the saliva, and the patient may suffer in his general health.

The old operation for parotid fistula was to enlarge the opening and pare off the edges of the fistula, cut into the mouth, and then pass a seton of silk or leaden wire through the opening. One end of the seton was left hanging into the mouth, the other out of the external wound. This was removed after a day or two, and the external wound was closed by harelip suture. The method of operation which I recommend, and which is now usually performed, is to pare the callous edges, by including them in an elliptical incision, and cut through about two-thirds of the thickness of the cheek. The operator then takes two large straight needles, attached to a seton composed either of silk or leaden wire. One needle is passed through the opening parallel to the line of the duct, and the other is passed lower down and more horizontally, leaving a considerable space of the undivided mucous membrane of the cheek between them. Both needles are drawn through into the mouth, so that both ends of the seton hang into it, that the saliva may be guided in that direction. Lastly, the raw edges of the external wound are brought into close contact by silver suture. This operation is more difficult to describe than to perform, but I consider it much more likely to be successful than the old method of treating salivary fistula.

Wounds implicating the parotid gland itself are not liable to be followed by salivary fistula. For a time saliva is discharged from the wound, but as it cicatrises, the textures consolidate, and the wounded part of the gland is obliterated and ceases to secrete. Should the wound be prevented from healing by the oozing of saliva, pressure, or a touch of a heated wire, will be found effectual in promoting the cure.

Wounds of or in the vicinity of the orbit require attention, as they may affect the functions of the eyelids or lachrymal ap-

paratus, or injure the eyeball itself. Thus wounds of the cheek or forehead, with loss of substance, may, by their contraction, lead to eversion of the eyelids—ECTROPION; or wound over the upper margin of the orbit may, by implicating the levator palpebræ, cause drooping of the upper eyelid—PTOSIS. The former condition may be remedied by removing a portion of the conjunctival surface of the eyelid, so that the contraction following its cicatrisation may counterbalance the external cicatrix; or other methods may be required, such as dissecting the margins of the contracted wound, and transplanting a flap to fill up the gap, and allow the eyelid to regain its natural position. Ptosis, arising from division of the levator muscle, is not remediable by surgical interference, but after a time the divided muscle forms adhesions, and sometimes acts to a certain extent in raising the lid. I have seen ptosis follow contusions and superficial wounds over the upper eyelid, apparently due to some affection of the nerve supplying the muscle. In some of these cases, a long time elapsed before the power was restored. In such circumstances, after a time, blistering over the superciliary ridge, and sprinkling the blistered surface with a minute quantity of strychnia (about the $\frac{1}{12}$ of a grain) every third day, will be found useful in restoring the nervous power.

Wounds injuring the lachrymal sac or ducts, if they be attended to at first, and if the passage for the tears be kept open during the healing process, generally do well enough. If the inner part of the lower eyelid be drawn down during cicatrisation, and the punctum displaced, the tears pass over the cheek. This is remedied by slitting open the orifice of the duct, on its conjunctival side, that the tears may pass into their natural channel.

INJURIES OF THE ORBIT are always attended with danger to the eye, either by directly implicating that organ, or from the inflammation and suppuration which follow, affecting it secondarily. They may also prove fatal in some cases, from the wound penetrating the brain, or leading to inflammation in that direction, hence they require great attention to obviate bad results.

In cases where the eyeball is directly injured, if any foreign body be lodged in the cornea, or sclerotic, it should, if possible, be extracted at once, and then strict antiphlogistic treatment adopted to prevent mischief. In cases of wounds inflicted by gunshot, where pellets have passed deeply into the eyeball and orbit, the organ of vision is destroyed, and the presence of the foreign body may, and generally does, excite so much irritation as to necessitate excision of the eyeball, either alone or with the contents of the orbit, to save the other eye suffering, or diseased action extending back towards the brain. In cases of abscess of the globe of the eye following injury, but in which no foreign body remains, there is no need of excising the eyeball; all that is requisite is to open or completely remove the cornea, so as to evacuate thoroughly the contents of the globe, and apply poultices or warm-water dressing. This relieves the tension, and when the cure is completed, the stump of the eye left enables the patient to be better fitted with an artificial eye than if the eyeball had been removed.

When REMOVAL OF THE EYE is required, either on account of injury or disease, the nature of the operation will depend on whether we require to remove the eyeball alone, or to extirpate it along with the contents of the orbit. Wherever the injury or disease is limited to the eyeball, excision or enucleation, as it is now termed, is the operation to be performed. It is effected thus:—The patient being under chloroform, and recumbent, the eyelids are separated by an assistant or the wire-spring speculum; the operator with a pair of forceps and scissors raises and divides the conjunctiva a line or two from the cornea, as in the operation for squint, only the incision is carried round the whole circumference of the cornea. He next divides, one by one, the recti and oblique muscles. By means of a sharp hook fixed in the cornea, the eyeball is drawn forwards, the optic nerve cut, and the operation concluded. A piece of lint is pressed deeply into the wound to control the bleeding of the artery of the retina, the eyelids closed, and a compress secured over them.

The lint is removed from the wound in a few hours after the operation, and cold-water dressing applied.

EXTIRPATION OF THE CONTENTS OF THE ORBIT is a coarser and more bloody operation. The operator begins by dividing the outer canthus of the eyelids to get room for his after-proceedings: he next passes a needle, armed with a strong thread, through the cornea, that the thread may be used to fix and draw forward the eyeball. The eyelids being separated, the surgeon cuts the conjunctiva round the margins of the orbit, passes his knife backwards along the orbital plate of the frontal bone, taking care to keep its point directed downwards, and sweeps the blade of the bistoury rapidly round the orbit, the eye being drawn forward at the same time to put the textures on the stretch. If the optic nerve has been completely divided, the contents of the orbit are at once removed, or a touch of the knife completes the operation. A sponge is thrust into the orbit to control the bleeding until the surgeon is prepared to seize and secure the divided branches of the ophthalmic artery; a dossil of lint will generally require to be placed in the cavity to control venous bleeding or deep oozing from the central artery of the retina in the optic nerve. The eyelids are then closed and secured with compress and bandage, as in the former operation. The compress and the lint in the orbit are removed after some hours, and cold-water dressing applied over the eyelids.

In both these operations an opiate should be given to allay pain, and obtain perfect quiet to prevent bad consequences.

OBSTRUCTION OF THE NASAL DUCT, leading to distension and disease of the lachrymal sac, frequently requires surgical interference, and the kind of interference will depend on the nature of the obstruction, and the stage of the diseased condition we have to treat. The earlier symptoms of this obstruction are the trickling of the tears over the cheek, and dryness of the nostril of the affected side. The flow of tears over the cheek—EPIPHORA, or STILICIDIUM LACHRYMARUM—may have other causes, such as

increased secretion from irritation of the lachrymal apparatus, from obstruction of lachrymal puncta, or ducts, or from the puncta having been displaced, so that the tears are not directed into them. Or these symptoms may depend not on disease of the nasal duct, but be due merely to congestion of the mucous membrane covering the inferior turbinated bone, or the pressure of a nasal polypus obstructing the free passage of the tears at the lower opening of the nasal duct. The surgeon must therefore examine carefully as to the cause of the stillicidium, and treat the case accordingly. If due to over secretion, the treatment is to remove the source of irritation, and use sedative and astringent collyria. If the puncta or lachrymal ducts are obstructed, dilatation of the puncta and canaliculi by means of Anel's probes should be had recourse to. If the lower punctum be everted from the result of injury or disease, the simple operation recommended by Mr. Bowman of introducing a fine grooved director into the duct, and then slitting it up on its conjunctival aspect, so as to restore a direct channel for the tears, will prove effectual. When the obstruction is at the lower opening of the nasal duct, then relieving the congestion, or removal of the polypus, is the evident indication. When, however, there is stricture of the nasal duct, the tears gradually accumulate in and distend the lachrymal sac; irritation of and increased mucous secretion from the lining membrane of the sac takes place, and unless actively and properly treated, inflammation and suppuration follow, and fistula lachrymalis may be the result.

There is little use in such cases to try the introduction of dilating instruments, such as probes from the nostril, and still less in putting off time by fomentations or anodyne lotions applied over the distended sac. It is in this early stage, before suppuration has begun, that Mr. Bowman's operation for, or rather to prevent, fistula lachrymalis is most advantageous. It is performed thus:—The lower punctum is first dilated by Anel's probe, or by the point of a common pin, and then a fine grooved director is passed along the duct into the sac: along the groove of the director the surgeon glides a thin-bladed knife, an ordinary cata-

ract knife for example, and slits open the canal into the sac. This permits him to introduce a silver probe, sufficiently strong, to pass along the nasal duct, and overcome the obstruction. The distended sac is then emptied of its contents, and tepid anodyne lotions applied over the position of the sac for a few hours to allay irritation. In two or three days the probe is passed again, and followed up by a larger one, and thus at intervals gradual dilatation of the duct is effected, and its function restored, without any deformity being left. If, however, suppuration has occurred, with much inflammatory swelling in and over the sac, then Bowman's method will not suffice; for not only will it not permit free exit for the pus and other inflammatory products, but the gradual dilatation cannot be properly carried out. The suppurating sac should be opened like an ordinary abscess, and its contents freely evacuated, and a probe passed down through the canal. Afterwards, when irritation has ceased, dilatation is carried out, at first from above, but after a time I introduce the probe from below, to permit the opening in the sac to heal.

In cases where the lachrymal sac has been allowed to burst, and no means have been used to clear the nasal duct, the tears pass from the sac through the opening, constituting the condition termed FISTULA LACHRYMALIS; and for the cure of this a special operation is generally described. The operator makes tense the eyelids, so as to render the tendo oculi distinct, inserts the point of a narrow bistoury below the tendon, directing the edge outwards, and the point backwards and downwards into the nasal duct; then partially withdraws the knife and passes a probe along the blade, and finally lodges a style in the duct; and after a few days removes this, and gradually introduces larger styles, till the duct is fully dilated; then a very fine style with an enamelled head is left in permanently. For my own part, I never could see the necessity for this special operation. The external aperture must communicate with the sac, and all I have ever found necessary has been to dilate the existing aperture, and pass a probe into and along the nasal duct by giving it the proper direction, and then carrying out gradual dilatation.

FRACTURES OF THE BONES OF THE NOSE do not require much notice. The fracture is easily diagnosed, and if seen before much swelling has occurred, we can ascertain if there be deformity, and its nature. In young persons the septum nasi yields laterally along with the nasal bones, and the result is a twisted appearance of the nose. At other times, as from a direct blow, the septum and nasal bones are flattened, and then we have the "Fancy Nose" resulting. In all cases there is more or less epistaxis from rupture or laceration of the lining membrane. When the nature and direction of the deformity are ascertained, we pass a director, or the handle of a penholder, or closed dressing forceps, within the nostril, and model the bones into position, and leave them thus without any interference afterwards. We should not, except in special cases, push lint up the nostril to keep the bones in position, for that is very apt to lead to suppuration and necrosis, especially if it be a compound fracture. These fractures usually unite readily enough, and little or no deformity is left if the treatment be adopted early.

FOREIGN BODIES, such as peas, beads, portions of slate-pencil, or small pebbles, are frequently lodged in the nostrils by children in their play; and when they find that the substance cannot be blown out of the nostril, they or their friends make matters worse by ineffectual attempts to remove the substance. In some cases of older children, the accident is concealed until the irritation of the foreign body has caused inflammation and discharge from the nostril. If the patient be seen before attempts have been made to extract the foreign substance, there is no great difficulty either in ascertaining its position or removing it. But if there has been interference, the foreign body is generally pushed further back or upwards, and its position is hidden by the bleeding which has resulted from such interference. In cases where the substance has been impacted for some time, the inflammatory swelling and the discharge hide it, whilst the extreme tenderness of the inflamed mucous membrane prevents manipulation, except the

patient be put under the influence of chloroform. In uncomplicated cases the foreign body can be easily seen and felt. The patient should be placed opposite a clear light, and his head held firm by an assistant. The surgeon then introduces a strong flat probe, or an ear-scoop lever, over and beyond the foreign body; but, before attempting to extract it, he should introduce his finger into the mouth to obstruct the posterior nostril, for if the foreign body were dislodged backwards whilst the child is struggling and crying, it might be drawn into the larynx and cause suffocation, or at least necessitate the immediate performance of tracheotomy; hence I always adopt the precaution I have mentioned. In some cases a pair of polypus forceps may be used to extract foreign bodies of a flattened form; but the lever-scoop generally answers best. In cases where ineffectual attempts have been previously made, or in which inflammatory swelling is present, the nostril should be gently syringed with tepid water, to remove blood or discharge and allay irritation. Then the patient should be brought under the influence of chloroform, and the extraction effected as already described. Should there be any doubt as to the presence or position of the foreign body, the nasal speculum should be used, after we have washed out the nostril to remove blood or discharge.

EPISTAXIS, or BLEEDING FROM THE NOSE, frequently follows all accidents or operations about the nostrils. The hæmorrhage is often of a serious character, and requires efficient means to arrest it. This form of bleeding also occurs idiopathically in patients in whom there is a tendency to cerebral congestion or disease. When we do not wish to check it very rapidly, the application of cold, or plugging the anterior nostril, may be sufficient to arrest it. This is, however, seldom sufficient, for if the bleeding be at all serious, it will take place by the posterior nares, and the blood will pass into the stomach, giving rise to vomiting, and the patient may suffer from the loss of blood. Hence we generally plug the posterior nares first, and then the anterior, so as to

command the bleeding completely. Various instruments have been invented for the purpose of plugging the nostrils, but an ordinary gum catheter is quite sufficient. The stilette having been withdrawn, the catheter is introduced into the nostril and brought out of the mouth; a plug of lint secured to the centre of a piece of strong cord is then tied on it, and is drawn back into the posterior nostril, and firmly impacted there. Both ends

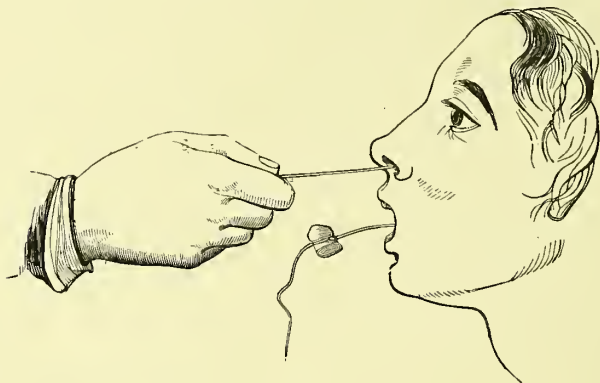


Fig. 8.

of the cord are then tied together loosely at the angle of the mouth. The plug is left in for forty-eight hours or so, and then drawn out from the posterior nostril. I do not approve of using a sponge for plugging the nostril, as it swells from the mucus and blood, becomes slippery, passes out of the posterior nostril, and hangs down the throat; but if a plug of lint be firmly lodged in the nostril, this is not likely to happen.

LECTURE XCVII.

Polypus of the Nostril : Simple ; Fibrous and Malignant ; their Symptoms and Treatment—Ozæna and its Treatment—Ulceration of the Septum Nasi—Rhinoplastic Operations : by Flaps from the Forehead or Cheeks—Liston's Operation for restoring the Columna Nasi—Partial Restoration of the Nose by Flap from the Arm.

SIMPLE POLYPUS OF THE NOSTRIL is a very common affection. I have already spoken of it, as an example of simple vascular sarcoma, when lecturing on tumours. The general symptoms which indicate its presence are a feeling of stuffing of the nose, as if from a cold in the head, and an increased secretion of mucus from the nostrils. As both these symptoms are increased in cold damp weather, the patient for some time attributes his symptoms to a cold ; but as they become persistent, and the difficulty of breathing through the nostrils becomes greater, he examines his nostril, and detects a soft swelling ; or some of his friends observe it. In many cases the bulky mass presses on the margin of the inferior turbinated bone, and obstructs the flow of tears through the nasal duct, and they then flow over the cheek, giving rise to one form of Epiphora. When any of the polypi project towards the pharynx through the posterior nares, the patient feels as if some mucus were adhering to the back of the throat, and is constantly hawking and spitting to get rid of it. When very long and pendulous in this position, the irritation of the fauces sometimes excites vomiting. In many cases the projection of a polypus may so press upon the orifice of the Eustachian tube as to cause deafness. In all cases, as the growths enlarge and fill the nostril, the sense of smell is impaired, and the voice is indistinct and snuffling, and when the patient falls asleep he snores loudly.

In some extreme cases, more especially in cases of fibrous

polypi, great deformity occurs ; the nasal bones and the walls of the antrum yield, and the face assumes the character termed "Frog-face," represented in the woodcut (Fig. 9). In some cases



Fig. 9.

of fibrous polypus, portions of the growth invade the orbit, and evert and protrude the eye, and at the same time distend the antrum and press down the palate so as closely to simulate malignant tumour of the upper jaw.

There are generally several polypi present at the same time in the nostril, and often several small ones are sessile around the roots of the more prominent ones. Hence it is sometimes said that these simple polypi return after removal. This is not the case ; but the small ones constituting the second crop, and which were formerly unnoticed, grow up, and occupy the room

vacated by their more advanced predecessors. It is therefore not a recurrent tumour ; but we cannot always be sure of removing every polypus. Their most usual habitat is the mucous surface of the superior and middle turbinated bones. From this position they often hang in clusters down the nostrils. A polypus occupying the anterior nostril, with a long narrow attachment, may slip backwards into the posterior part. We should, therefore, always introduce a finger into the mouth, and feel the posterior nostril, in order to ascertain if there are any polypi there.

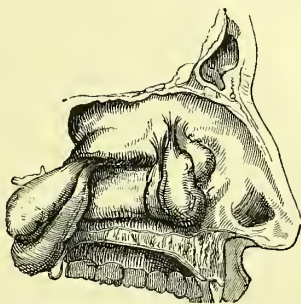


Fig. 10.

The diagnosis of nasal polypus is usually simple enough ; at the same time, we must see that it is really a polypus we have to deal with. It often happens that a patient has the ordinary symptoms of polypus, and that the surgeon supposes he sees one when there are none present. The mucous lining over the inferior turbinated bone is often congested and cedematous, and looks exactly like a polypus, and the septum between the nostrils is sometimes placed unevenly, and has the appearance of a polypus. Hence we require to be careful in examining the nostril ; but once we have ascertained the presence of such a growth, the treatment is very simple.

To remove these simple polypi, we introduce a pair of polypus forceps into the nostril, by means of which a firm hold is taken of the root of the polypus ; which is then wrenched or twisted off from its attachment. This is repeated until all the growths which can be seen or felt are removed.

In some cases, where there are a number of small polypi which are difficult to get hold of, I proceed as if I were going to plug the posterior nares, by using a small plug, and drawing it forwards. By this means I often drag away any small polypi which may be present ; and though it looks a harsh proceeding it is not a painful one.

We meet with other kinds of polypi besides the simple ones. We may have a FIBROUS POLYPUS occupying the whole nostril and hanging down the throat. This form of growth is very firm, and is generally attached towards the posterior nares or pharynx. When in that position, we can, by means of a pair of strong toothed forceps, twist them out ; but when otherwise situated, we may have to slit open the nose or perform excision of the upper jaw, as, especially in young subjects, there is a risk of the bones of the base of the cranium yielding if great force be used. In some cases we can snare them in a loop of double-twisted wire, which may then be used as an *écraseur* to separate the polypus gradually, and extract it by the mouth, or we may tighten the wire from time to time till the polypus drops off.

Another form is the MALIGNANT POLYPUS. This is rather a malignant medullary tumour than a polypus, and its character is known by the bleeding from the nostril, the age of the patient, and the nostril becoming rapidly plugged up. We should not remove it, for it would recur again immediately, and the great mass of the growth is deeply situated, springing from the ethmoid cells, so that it would do no good to remove merely the projecting portion. Besides, such operations are likely to be followed by excessive hæmorrhage, which is very difficult to arrest.

OZÆNA is a disease of the nose and frontal sinuses, characterised by a thin and foetid discharge. The odour of the discharge is peculiar—not a strong but a very offensive fœtor. On examining the nostrils, the mucous membrane seems swollen but not very vascular, rather of yellowish tinge, but in some instances congested. On examining the nose with the speculum in a strong light, if the disease is at all advanced we observe numerous superficial aphthous sores, not larger than the surface of a millet seed. The patients are generally pale and unhealthy looking. In truth, the disease is one of the manifestations of scrofula in most cases, although some elderly people otherwise healthy have told me that the discharge had existed for nearly half their life-

time ; but these are exceptional cases, and in most of them the discharge of thin mucus was chiefly from the frontal sinuses. The treatment of ozæna consists first in using means to improve the general health, by administering iodide or bromide of potassium, cod-liver oil and iron, and generous diet. The local treatment I usually adopt at first is to make the patient apply a lotion of Condyl's fluid to the affected membrane by means of a hair pencil or syringe, and once or twice a day sniff up the fumes of tincture of iodine diffused in boiling water. When the apthous sores are present they should be brushed over with a solution of sulphate of copper from time to time, the Condyl's fluid being used as an ordinary wash. In many cases great benefit is derived from blisters applied behind the ear. In cases where the membrane of the frontal sinuses is affected, the blister should be applied to the forehead. These cases are always tedious, and exercise the endurance both of the patient and the surgeon.

ULCERATION OF THE SEPTUM NASI is sometimes met with, and has often progressed to perforation before the patient's attention is drawn to it. In most cases it begins in a small pimple or pustule on one side of the septum. This is irritable rather than painful, and the patient does not think of applying for medical advice. The irritation leads him probably to be touching the part, or he picks the pimple, and so an irritable ulcer is formed which gradually eats through the septum. On discovering the hole, the patient becomes alarmed, and seeks surgical aid. Such ulcers almost invariably assume the circular form, their edges are irritable, and the surrounding texture congested at first ; but they often assume a low chronic action from a very early period, with somewhat callous margins, which cicatrise from time to time, and then break out afresh, and so the ulcer extends until the septum may be undermined and give way. In almost all the cases I have seen there have been constitutional causes in operation ; either scrofula, or that and hereditary syphilis combined, or the ulcer has occurred as one of the symptoms of tertiary syphilis. In a few cases it seemed to be the

result of mere local irritation, and in these the cure was correspondingly speedy and complete. You will understand from what I have just said that attention to the constitution generally forms the principal part of the treatment, which must be conducted on the general principles already laid down. The local treatment consists in the direct application of nitric acid to the sore, to destroy the diseased parts, and arrest the action. This should be followed by the use of Condyl's fluid diluted with distilled water, and at a later period lotions of sulphate of copper, or chloride of zinc, may be required to assist the healing process. Patients are often anxious that the opening in the septum should be closed, and are disappointed when they find it does not close under the treatment ; but they should be made to understand that the object is to arrest the spreading of the disease, and that contraction or closure of the ulcerated aperture cannot be expected. Plastic operations, or rather attempts at them, uniformly fail, from the sloughing of any flap introduced, the secretion of the nostril interfering with union ; besides, paring the edges of such an ulcer is almost sure to re-excite the local ulceration.

When lecturing on the subject of lupus, I adverted to the plastic operations which we sometimes have recourse to, with a view of restoring the nose, and remedying deformity. I did so then, warning you against performing such operations until a considerable period had elapsed after cicatrisation of the ulcerated surface. Even after a lapse of time, such cases are liable to recurrence of unhealthy action, and our plastic operations may be unsuccessful. Still, in many such cases, when the disease has been healed for some time, and the patient's general health restored, or in cases where the nose or portions of it have been lost from injury, we have recourse to operative measures to remedy the deformity.

When I was a student, RHINOPLASTIC OPERATIONS were very fashionable, and very great favourites with Mr. Liston. The method he pursued, and which was then generally practised, was a modification of the native Indian plan, represented in the accompanying

woodcut (Fig. 11). The flap was taken from the forehead, and the columna afterwards formed from the upper lip ; the latter a modification first used by Mr. Liston, and one of great importance in whatever method the nasal flap is formed. Albeit there was no chloroform in these days—the operation, a tedious, and, I should think, a painful one—the applicants for improved appearance were numerous, for “pride feels no pain ;” and I well recollect on one occasion seeing three of these operations performed by Mr. Liston in one day, and two of the patients sitting with the nasal flaps hanging down, till the oozing ceased, whilst the third was undergoing the operation.

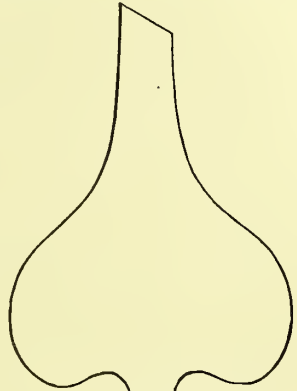


Fig. 11.

But although I had the advantage of seeing the operations of a master-hand, I never was favourably impressed with the results ; more especially as it always appeared to me that the peculiarly disagreeable expression, resulting from the cicatrisation of the large wound on the forehead, more than counterbalanced any improvement from the restoration of the nose. As years passed on, and I had opportunities of seeing many of the patients on whom these operations had been performed, this adverse opinion was confirmed, for the “renaissance,” which had some appearance of a nose when first made, had almost in every case become “small by degrees,” *not* “beautifully less”—in fact, degenerated into a sort of indefinite lump where a nose should be. In some cases, where the original flap had been of such dimensions as to provoke a little merriment at the time of its adjustment, a somewhat better nose remained, but never such as to me seemed any great improvement, whilst the ugly expression caused by the scar in the forehead had certainly not improved. From this feeling, I have never performed the rhinoplastic operation by that method, nor can I recommend it. But in cases where the

cheeks are full, and their textures healthy, and in which the septum nasi is tolerably entire, a very presentable nose may be formed by flaps dissected from the cheeks by the following method :—Two thick flaps of skin, of the form shown in the accompanying woodcut (Fig. 12), are traced on the cheeks, and then

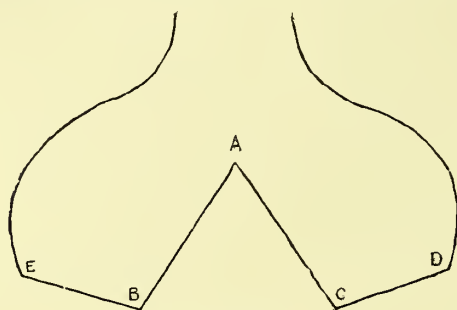


Fig. 12.

dissected up, taking care to retain sufficient substance to ensure vascular supply. These flaps are then brought forward without twisting, and, when all oozing has ceased, the margins A B and A C are approximated and

retained by points of silver suture. The outer margins at E and D are attached by silver suture at such a distance from the openings of the nose as would correspond to the original alæ nasi, and the remainder of the outer free margins implanted into the raw surface by points of silver suture, or small pins pushed in obliquely. After the lapse of forty-eight hours a small dossil of lint may be introduced to raise the flaps and give form to the nose, and that elevation is gradually increased after union has taken place. Lateral pressure from without by forceps made for the purpose may also be used with advantage at a later period, but the effects of pressure must be watched. Lastly, when two or three months have elapsed, and union is thoroughly effected, the columna nasi is formed by cutting it from the upper lip, as first practised and described by Mr. Liston. “The inner surface of the apex is first pared. A sharp-pointed bistoury is then passed through the upper lip—previously stretched and raised by an assistant—close to the ruins of the former columna, and about an eighth of an inch on one side of the mesial line. The incision is continued down, in a straight direction, to the free margin of the lip ; and a similar one, parallel to the former, is

made on the opposite side of the mesial line, so as to insulate a flap about a quarter of an inch in breadth, and composed of skin, mucous membrane, and interposed substance. The frænulum is then divided, and the prolabium of the flap removed. In order to fix the new columna firmly and with accuracy in its proper place, a sewing needle—its head being covered with sealing-wax to facilitate its introduction—is passed from without through the apex of the nose, and obliquely through the extremity of the elevated flap : a few turns of thread over this suffice to approximate and retain the surfaces. The flap is not twisted round as in the operation already detailed, but simply elevated, so as to do away with the risk of failure. Twisting is here unnecessary ; for the mucous lining of the lip, forming the outer surface of the columna, readily assumes the colour and appearance of integument, after exposure for some time, as is well known.” The fixing of the columna having been accomplished, the edges of the lip must be neatly brought together by the twisted suture, or silver wire suture, as in hare-lip, after the edges have been raised. “Some care is afterwards required, from both surgeon and patient, in raising up the *alæ*, by filling them with lint—thus compressing the columna, so as to diminish the cedematous swelling, which takes place in it, to a greater or less degree, and repressing the granulations. It is, besides, necessary to push upwards the lower part of the column, so that it may come into its proper situation ; and this is done by the application of a small round roll of linen, supported by a narrow bandage passed over it and secured behind the vertex.”

The wounds of the cheeks from which the flaps have been dissected are stitched at the outer parts, and closed as far as can be done without straining the skin. The remainder heals by secondary union, and the contraction which follows rather improves the appearance by projecting the new nose more in relief.

Partial restoration of the nose can be practised with very great benefit by transplanting portions of the cheek texture to supply the deficiency ; and as the opposite side of the nose

and septum are present, the results are very satisfactory. The flaps should be cut with a long and somewhat narrow but very thick pedicle, to avoid the necessity for twisting ; but so thick as to retain ample vascular supply for the flap. Their shape must vary in different cases ; but the accompanying figures will give some general idea of their form. When the

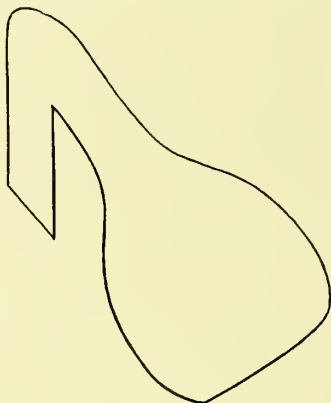


Fig. 13.



Fig. 14.

flaps are taken from the cheek, there is no deformity left from the scar, so that, even if the operation fails, the patient is no worse than before ; whereas, in the forehead flap, great deformity remains. In the case of a lady who, in childhood, had suffered from *cancrum oris*, which destroyed one side of the cheek and nose, I restored the cheek and form of the mouth by dissecting a flap from the neck, but I could not get sufficient to form the side of the nostril, and I advised her to get an artificial substitute. Eighteen months afterwards, however, she returned, with the determination to have the side of the nose repaired by operation. Of course I could get nothing from the cheek in her case, and I explained my objection to cutting a flap from the forehead. But as she was very determined to have something done, I told her that if she could bear a very irksome after-treatment, I would form the side of the nose from her arm. She at once decided to have it done ; and I accordingly cut a large flap from the inner and anterior aspect

of the upper arm. After paring the edges of the nose and cheek, the flap was fitted and attached by sutures, the arm was supported by an apparatus specially arranged to suit the case, and retained in position for eight weeks before I could venture to sever the attachment of the flap. I was at first rather anxious as to union at the part attached to the margin of the recently-formed cheek, but everything went on favourably, and my patient's firmness was rewarded by a decided improvement in her appearance. I should, however, think very few persons will be found who would carry out the treatment or bear the irksome position of the arm with the determination she did.

LECTURE XCVIII.

Ulcers of the Lips—Epithelial Cancer of Lip : Operations for its removal ; Cheiloplastic Operations—Harelip and Cleft Palate : Operations for the remedy of these Congenital Deformities.

WE have too little time to enter fully into the details of the numerous surgical diseases about the mouth. I shall therefore merely notice the more important points.

The LIPS are subject to various forms of ulceration, some simple, from mere local irritation, the effects of cold, or from disorder of the digestive organs. Such ulcers are generally of an aphthous character, and require little local treatment beyond protecting them from exposure to fresh irritation. The constitutional treatment must depend on the predisposing cause. When speaking of syphilis, I stated that occasionally we meet with chancres of the lip, and mucous condylomata. These latter, when ulcerated on the surface, may lead to wrong diagnosis, as the local appearances very closely resemble those of certain forms of epithelial cancer of the lip, and therefore the surgeon requires to be cautious in his diagnosis, especially when the ulcer is present in young persons, in whom epithelial cancer is not common. In most instances the co-existence of eruptions, or the marks left by eruptions on the skin, and the state of the throat, will confirm his suspicions, if the ulcer be of a syphilitic character, and then the adoption of the treatment proper to that condition will speedily cure the local sore.

The CANCROID AND CANCEROUS ULCER OF THE LIP is most frequently met with in the lower lip in old people, and the exciting cause is often traceable to long-continued local irritation, caused

by smoking a short pipe, or by the presence of some irregular tooth. The characteristics of such ulcers are a warty and villous



Fig. 15.

irregular surface, and extreme hardness of the base of the sore. They vary much as to extent, and the direction in which they extend. Thus, some are confined to a small space of the prolabial surface, but the hardness involves the textures of the lip towards the chin, or angle of the mouth. Others extend very superficially along the length of the prolabium; or the surface and some depth of texture may be affected, whilst the skin and mucous membrane of the body of the lip may be unaffected. The *Treatment* is excision of the diseased part before the glands have become involved. There is no use in trying escharotics, as it will be found that even when the surface of the sore heals after destruction of the ulcer by such means, gland-tumours form in the submaxillary region, whilst their application is much more painful than the operation of excision. We must vary our procedure according to the position, form, and extent of the disease. In the smaller and more defined cancrioid ulcer of the lip we

include the diseased part in a V-shaped incision, and remove the part so marked out, taking care to cut wide of the disease. In making the incisions, the texture of the lip should not be stretched by the assistant, as that is liable to render the surrounding hardness less distinct. The bleeding should be commanded by pressure on the facial artery against the lower jaw in front of the masseter muscle, and the lip held loosely whilst the incisions are being made. After the cancerous portion is excised, the vessels are twisted, and the margins of the wound approximated by silver sutures, so that little deformity is left. In cases where the warty ulceration occupies the length of the prolabium superficially, we project the ulcerated surface, and remove it with a pair of curved scissors, and unite the edges of the skin and mucous membrane. If there be some depth as well as length of surface involved, we include the diseased part between the lines of a prolonged elliptical incision, and dissect off the skin and prolabium, remove the diseased structure, and then, after securing the vessels, re-unite the margins of the skin and prolabium. In many cases the disease involves so much of the substance of the lower lip that its removal would necessarily leave the teeth exposed, and allow the saliva to be constantly running out of the mouth. In such cases our procedure ought to be so arranged that we may at once remove the cancerous part, wide of the disease, and at the same time replace it by a substitute lip, formed by what is termed the Cheiloplastic Operation.

Suppose we have to deal with a cancerous ulcer with induration, involving a large extent of the lip both in length and depth, we begin by making two incisions, one from either angle of the mouth, converging at the chin; we then dissect away the triangular part included. By means of these incisions we remove the whole diseased lip, and mark out part of the flaps from which the new lip is to be formed. From the apex *b* of this large V-shaped incision (Fig. 16) we next carry downwards and outwards two oblique incisions to the points *d* and *e*, and then with a curve to *f* and *g*, we mark out two flaps in the submaxillary region. The flaps are now to be dissected from over the

lower jaw and submaxillary region, and detached so far as to enable us to bring them into the positions indicated in Fig. 17,

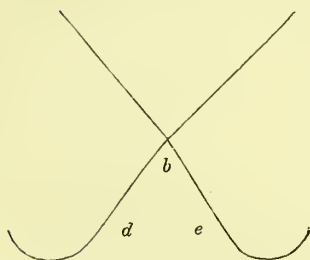


Fig. 16.

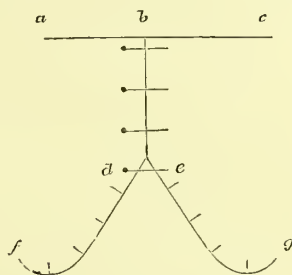


Fig. 17.

of the accompanying woodcut, without straining or twisting. Finally, the cervical wound is closed as far as possible without giving rise to tension. The laxity of the skin in the cervical region allows this to be done to greater extent than we might expect, and the cervical wound heals by granulation.

Various plastic operations are required to remedy partial destruction of the lips and cheek, resulting from cancerum oris, or other causes, but it is impossible to lay down rules for such irregular operations. The surgeon must plan the operation to suit each particular case. In planning such plastic operations, I would refer you to what I said when speaking of plastic operations for removing deformities caused by burns.

HARELIP consists of a congenital gap through the substance of the upper lip, involving its whole thickness. It is sometimes associated with deficiency of texture, and always presents that appearance, owing to a wide gap being caused by the unopposed muscular contraction on either side of the fissure. This gap, or deficiency, not only exposes in an unseemly manner the teeth and gums, but so interferes with the proper functions of the lip as to render eating difficult, and proper articulation impossible. The expression of the face is necessarily very much altered by it, and the discomfort and deformity are generally so great as to induce the parents to seek surgical aid at an early period.

The fissure may be single or double ; and it may be complete or partial in its extent. A complete fissure severs the whole lip, and extends up into the nostril (Fig. 18) ; a partial one

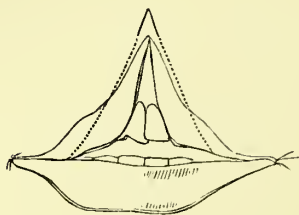


Fig. 18.

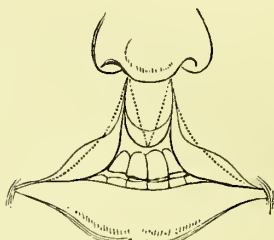


Fig. 19.

divides the lip to a greater or less extent, in the same direction, without extending so far as the nostril. Whether there be one or two fissures, neither is ever situated in the middle line, but to one or other side of it ; hence the term harelip does not accurately describe it. When there are two fissures, the groove below the columna of the nose is generally represented by an island or isthmus of sound skin, it being sometimes separate from, and sometimes continuous with, the septum of the nose—generally the latter (Fig. 19). This is taken advantage of in operating, as I will afterwards show you. In addition to this, there is usually an irregularity in the alveolar process, corresponding to either or both notches in the lip. This deformity may assume the character of either a deficiency or redundancy, very frequently the latter. An inter-maxillary bone is frequently present, and projects at the fissure. Sometimes the alveolar process is divided, and a portion of it, with its corresponding tooth or teeth, turned curiously outwards, as if in adaptation to fill up the gap in the lip.

The *Operation* for Harelip may be performed at almost any period of life ; but where you have a choice the preferable time is early infancy, or after the first dentition is complete, and the child two years old. As the lip, after being operated on, is apt to shrink upwards into a modified notch, marking the site of the original fissure, the great desideratum in connection with the operation is a lip free from this defect. With the view of effecting this, it

is desirable to leave a redundancy of texture at the lower portion of the wound. The operation consists in paring or rawing the labial margins of the gap, then placing them together in close and accurate apposition with points of silver suture or harelip suture ; but in order to get a redundancy of texture at the margin of the lip, it is necessary to employ either angular or elliptical incisions, both of which I have used with success. The angular incision is begun on either side at a point above the base of the fissure, and brought down in a straight line to the upper margin of the prolabium, where it is directed inwards at an obtuse angle (Fig. 20). Thus, when the two straight edges are brought together, the labial margin will be excessive rather than defective ; but the excess will soon be remedied by absorption. You will readily understand that a like result will be obtained, and perhaps in a simpler manner, by employing two curved incisions, their concavities being directed towards each other, so that when the lips of the curves are approximated and brought into line, the lower extremity of the united line will exhibit a redundancy of texture. This is the mode of operation I generally employ, and its simplicity and success have decided me in giving it the preference for most cases of harelip. After the margins have been closed by silver sutures, the mucous surface should be secured by a point of silk suture, to prevent saliva entering the deep aspect of the wound.

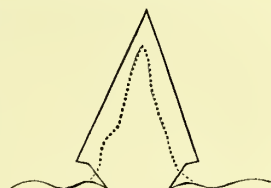


Fig. 20.

The operation for the double deformity is conducted on the same principles, and must, of course, be modified according to circumstances. Where there is an isthmus of skin depending in the middle line, I raise it up and employ it in supplementing the columna of the nose, which is generally defective. This I find to be more advantageous than to pare it into a wedge-like form, and employ it in patching up the new lip, as is sometimes done, as represented in Fig. 19. When the intermaxillary bone is present, we either break its narrow pedicle

and forcibly repress it into position, after dissecting off the soft parts, or we divide the pedicle with bone-pliers, and remove the bone. The former is the preferable method when we can adopt it. In either case it should form a preliminary operation.

The mistake you are likely to commit as beginners is to remove too little texture in paring the edges. This conservatism is suggested by the apparent dearth of material to supply the existing defect ; but that deficiency is more apparent than real. In drawing the edges of the wound together, we have to draw largely on the elasticity of the component textures ; and lest the sutures should of themselves be insufficient to keep the ground we have gained in this way, we generally draw the cheeks towards each other by strips of adhesive plaster, causing the lip to pout.

This can be done more effectually by means of an apparatus, formed somewhat like a double truss, consisting of a circular spring and two pads. The spring is applied round the back of the head, and the pads are adjusted so that one is made to impinge on either cheek. It is kept in position by means of a cross strap applied over the forehead and vertex. I have never myself used this, but it has been found of advantage.

The bleeding must be arrested by torsion. No approximation must be attempted until it has entirely ceased, unless we use the harelip-needles, when these are made to compress the vessels.

Chloroform may or may not be used. If given, care should be taken that the child has had no food for some hours before the operation, lest it cause sickness.

The condition known by the name of CLEFT PALATE consists of a congenital malformation, in which the arch forming the roof of the mouth, instead of being continuous and entire, is interrupted by a longitudinal fissure or gap in its substance. This deficiency may be partial, affecting the soft palate only, or it may be complete, involving the hard palate also. Sometimes aggravated forms of it are met with, in which the fissure extends forwards through the alveolus and upper lip into either nostril ; and there are minor degrees of it, in which the fissure is repre-

sented by a short oval slit in the vault of the mouth, bounded both anteriorly and posteriorly by sound parts. Various explanations of its origin have been advanced. Some refer it so far back as to make its commencement coeval with the closure of the first visceral arch in the embryo. Others date it from arrested development at a later period ; while a third theory attributes it to separation of the still imperfect parts by causes distending the foetal head.

The *Operation for Split Palate* cannot be shown properly on the dead subject unless the malformation be present. When the soft palate alone is involved, the operation required is comparatively simple. What we have to do is to pare the edges of the slit in the palate, and bring them in contact by points of suture. The danger is that the tension may cause the sutures to ulcerate out. Moreover, the constant irritation of the part by saliva and foreign substances in the mouth, and the attempts of the patient to swallow, are apt to break up the newly-united edges, and render the after-treatment rather troublesome. Still the operation for the soft palate is comparatively a simple one. Various methods have been proposed to relieve the tension. Sir William Fergusson proposes to divide the muscles which render the palate tense, and also to divide the muscular fibres contained in the pillars of the fauces, the palato-glossus, and palato-pharyngeus. This renders the tension somewhat less, but the injury done by interference with the soft textures, and the division of the muscular fibres, may lead to suppuration, and so defeat the object we have in view.

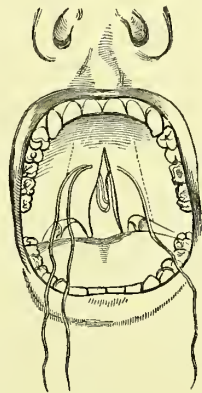


Fig. 21.

In bringing the edges of the wound together, we should use silver instead of silk sutures, as silk creates more irritation than the silver wire. In putting in the sutures, I leave a considerable space between the points where the needle is inserted and the free margin, so that there may be a considerable thickness of texture intervening. Five or six sutures should be inserted

in all. Formerly there was sometimes a difficulty in getting hold of the right ends of the sutures, but an instrument has been invented which obviates this difficulty—a coronet with projecting pegs, to which the ends of the sutures are fixed.

In the other form of the disease there is a split and deficiency in the hard as well as in the soft palate. Langenbeck and others have lately introduced a method of operating for this condition, founded on the researches of Ollier with regard to the periosteum. He fills up the gap in the hard palate by separating the gum-texture, and the periosteum along with it, from the palatine surface, and pushes it in towards the cleft. This operation is much more difficult than the former, and requires much time and patience in its performance. Very careful dissection is required in separating the palate from the arch of the mouth, and the palatine plate of the superior maxilla and the palatine bone proper are generally much more vaulted in such cases than usual. The first thing is to pare the edges, both of the soft and hard palates; then make an incision with a bistoury close to the edges of the gum, on either side, leaving a small portion in front unseparated, so as to preserve its vascular connections entire; then, with a double-edged knife curved on the flat, separate the periosteal texture from the bone. This is done on both sides. It will generally cause considerable bleeding, and we must wait till this ceases before proceeding with the operation. When bleeding has ceased, we bring the parts together by points of suture, but this is not very easily done, and we require to have several needles for the purpose; the spring needle of Langenbeck answers best in most cases. The operation is a tedious one, and in many cases, after all, the result is unsuccessful. As a general rule, I think that the best plan in the more complicated cases, in the case of adults, would be to perform the operation on the soft palate first, and not to complete the whole operation at one sitting; rather than attempt too much. If the operation on the hard palate fails, it is very apt to implicate the soft palate. It would therefore be less troublesome, and more likely to be successful in many cases, to do the two parts of the operation on different occasions.

LECTURE XCIX.

Inflammation and Abscess of the Tonsils—Chronic Enlargement of the Tonsils—
Excision of Tonsils—Ranula and other Sublingual Tumours—Salivary Con-
cretions : their Symptoms, Diagnosis, and Treatment—Glossitis—Chronic
Hypertrophy of the Tongue—Ulcers of the Tongue—Epithelial Cancer of the
Tongue : Operations for its Removal—Tumours of Palate.

THE TONSILS are subject to attacks of inflammation, which may terminate in suppuration. There is great swelling in the throat, with difficulty of breathing and swallowing, and much fever in proportion to the extent of the disease. The patient is often very much exhausted also, from want of food, and much depressed from the irritative fever which is present. All these symptoms may be relieved by making an opening early, if suppuration be suspected to be coming on, for the pus may form very deeply in the tonsil. In no case is there any danger in cutting into the tonsil ; and an incision made to reach an abscess, even though the pus has not formed, can do no harm. It relieves the congestion of the parts, and in fact we often scarify the tonsil, just to modify the inflammatory action. We cannot of course feel fluctuation readily at an early stage of the disease in parts so deeply seated as the tonsil. A common bistoury is the best instrument for cutting into the tonsil, and it should be passed directly backwards in the line of the second molar tooth, the edge being directed inwards, for it is important to remember the close proximity of the large vessels of the neck to the base of the tonsil. There is no danger, however, to these parts, if the knife be passed fairly from before backwards into the abscess of the tonsil, and then carried upwards. The danger of non-interference in such a case is that the abscess may burst in the night, when the patient is asleep, and suffocation occur. From the congested state of the parts, we may, and

indeed pretty often do, have rather smart bleeding when we open the abscess, but we need not be alarmed at this, as it soon stops.

As regards CHRONIC DISEASES OF THE TONSILS, we have chronic enlargement of them with condensation of their texture. In delicate children this very often occurs, and they may attain to such a size that the two tonsils almost close up the fauces, and give rise to difficult breathing, especially at night when the patient lies on his back, and the nares become plugged with mucus. It is altogether a very unhealthy state of matters, for it interferes with the proper aëration of the blood, and therefore the sooner the disease is removed the better. The tonsils, on examination, are seen to be of a pale colour, and of a pretty firm consistence, though occasionally they may be somewhat vascular and spongy; these latter cases being not so favourable as the others. They nearly meet in the middle line, and they also project both upwards and downwards between the pillars of the fauces. In these cases, the simplest and the best treatment is the removal of the projecting portion of the gland—

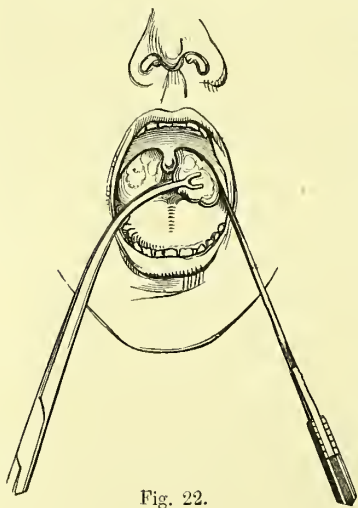


Fig. 22.

Excision of the tonsil, as it is generally called. This is an unfortunate name, for we do not excise the tonsil; we merely cut off a portion of it, and subsequently condensation of the remaining portion of the tonsil occurs, and the part contracts. To remove the tonsil, it should be drawn towards the centre of the mouth with a vulsellum, and then a straight probe-pointed bistoury is passed fairly below the projecting portion of the gland, and carried directly

upwards without any sawing motion, and to effect this the knife must be very sharp (Fig. 22). We should remove both tonsils

at the same time if possible, or the second may be removed a day or two after the first. There is seldom bleeding of any importance after the operation, but we must be careful not to drag the parts too much towards the mesial line, nor to cut too much outwards, for fear of injuring the important vessels. In children, it is sometimes not a very easy operation, from the small size of the mouth and other causes ; and chloroform, though it may be given, does not assist us much. An instrument called the guillotine has been introduced to obviate these difficulties ; but my objection to it is that it does not remove a large enough portion of the tonsil, and, besides, in children it is quite as difficult to use as the bistoury ; still, in some cases, it has been found useful. There is no after-treatment required beyond washing the mouth with warm water, and afterwards with alum gargle, and avoiding cold.

The term RANULA is applied to a cystic tumour in the sublingual region. On looking into the mouth we observe that the apex of the tongue is raised, and the body of the organ carried upwards and backwards, whilst the floor of the mouth is occupied by a large prominent swelling of a peculiar bluish tinge from distension with fluid, and covered by the mucous membrane. In some cases there is a sort of double swelling occupying both sides of the mouth ; in others, the tumour occupies only one side, but often presses over beyond the middle line as it enlarges. The swelling of course interferes with the use of the tongue and mouth ; the voice is harsh and croaking, hence the term *Ranula*, from the sound resembling the croaking noise made by frogs. Deglutition is interfered with, and even respiration may be seriously affected ; and in some cases suffocation has been threatened from rapid increase of the swelling. Considerable difference of opinion exists as to the nature of *ranula*. Some consider it a new growth, or true cystic tumour ; others, enlargement of some mucous follicles. Whilst some, with whom I am inclined to agree, consider the growth to depend upon obstruction of the sublingual and sub-

maxillary ducts, leading to gradual alteration in structure of the sublingual gland, somewhat similar to the cystic alteration which we frequently see take place in the pancreas and kidney from obstruction in their ducts. I think this is borne out by the uniformly constant position and relations of the tumour, the slightly sacculated appearance of the cavity when opened, and the double swelling we occasionally meet with. The objection to this view, that the contents are not like saliva, is not a very strong one. In all cases of affections of secreting organs the secretion becomes altered. In this case the secretion is more glairy than saliva, but it does in general contain most of the chemical constituents of saliva. The swelling is quite different in appearance from other independent cysts, with glairy or steatomatous contents, which are not unfrequent in this region, and which can be removed entirely, cysts as well as their contents. In ranula we cannot remove the cyst; it is evidently part of the natural structures.

Whatever view, however, may be taken of its pathology, there is no difference of opinion as to the *Treatment*, which consists in seizing the anterior wall of the swelling with a pair of artery-forceps, and cutting out a large oval portion of the cyst, evacuating its contents, and then painting the interior of its cavity with a strong solution of nitrate of silver, or strong tincture of iodine, to cause obliteration. This plan is usually quite successful, and far safer and less painful than passing a seton through the cyst to procure obliteration, which has sometimes been had recourse to.

Earthy Concretions form in the salivary ducts of the parotid sublingual, and submaxillary glands. THE SALIVARY CALCULUS occurs most frequently in the submaxillary duct, which it obstructs and distends. It gradually compresses a part of the gland-substance, and is felt from the neck. In whatever position these concretions form, they give rise, after a time, to inflammation and suppuration; the matter bursts externally by burrowing, and when it bursts, or is evacuated by the surgeon, there result long tortuous sinuses, which lead indirectly to the concretion,

and saliva continues to ooze through the openings. The irritation caused by repeated attacks of inflammation, and the continued loss of saliva, exhaust the patient. The cause may be overlooked, especially if the sufferer is otherwise of delicate constitution. In the submaxillary region the tumour caused by the concretion may be mistaken for a glandular tumour, and an operation proposed to excise it. This would be a very serious error if acted on, for between the supposed tumour and the skin, there is of course a great depth of parts, including the submaxillary gland, and the facial artery and vein. A little attention to the history of the case, and a careful examination from the mouth, would lead to a correct diagnosis. The remedy is comparatively simple. The concretion is fixed by pressure from below by an assistant, so as to render it prominent towards the mouth, and a free incision is made from the mouth through the mucous membrane directly upon the concretion, which is then easily turned out with the scoop of a director, or seized and extracted by a pair of polypus forceps. There is little thickness of parts, no vessel of any size need be divided, no external wound is left, and little or no after-treatment is required.

INFLAMMATION OF THE TONGUE.—GLOSSITIS may be excited by various causes, but the affection is sometimes apparently dependent on epidemic influences, and then assumes a very formidable character, and demands prompt and decided treatment. The organ becomes swollen, has a tense or brawny feeling to the touch, and is of a dark brown colour, with a sense of burning heat and pain, and the mucous membrane of the cheeks and lips is swollen. The swelling increases with great rapidity, and in some cases which I have seen, when the disease was prevalent here, the tongue swelled so rapidly as to separate the teeth and nearly fill the mouth in less than twenty-four hours from the invasion of the attack. There is a considerable amount of fever

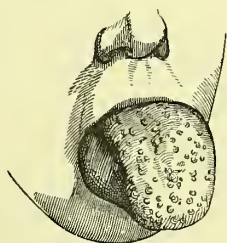


Fig. 23.

anxious expression of face, and difficulty in breathing ; indeed, unless prompt measures be adopted, the swelling of the tongue and submucous infiltration of the mouth and fauces, will speedily suffocate the patient. The *Treatment* of this active form of glossitis consists in freely incising the tongue in the longitudinal direction, keeping the incisions from the middle line. The incisions are made deeply through the infiltrated texture of the tongue, and afford relief, both by depletion, but especially by the escape of serous and plastic exudation, relieving the tension and swelling. The bleeding, in general, is much less than we might at first expect from incisions in so vascular an organ, but the incisions are not made so deeply into the proper texture of the organ as they seem to be. They pass into the infiltrated structure, and when the swelling subsides, the incisions, which seemed deep gashes when first made, appear as mere superficial scarifications. After the incisions are made, tepid lotions of honey and water, with chlorate of potash or borax, should be used to allay irritation, and the chlorate of potash may be given internally with advantage. The constitutional febrile condition must be treated on general principles, and during convalescence the use of quinine is specially indicated.

CHRONIC HYPERTROPHY OF THE TONGUE is not very common. In the cases which have come under my notice, the patients have been young, and the disease had apparently been progressing slowly from childhood, the enlargement proceeding more rapidly as the patient grew up. In these cases, although the tongue was of an enormous size, and hung over the chin, the interference with respiration was by no means such as in acute glossitis. The reason of this is, that the jaws and cavity of the mouth, and openings of the nostrils, seem to be gradually accommodated to the great alteration in the size of the tongue. Indeed, the lower

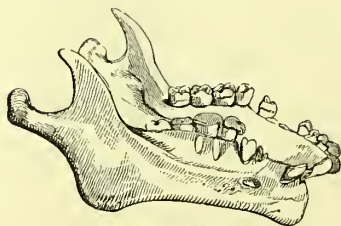


Fig. 24.

jaw, in such cases, is quite altered in form, so as scarcely to resemble the human jaw. This will be seen in the accompanying woodcut (Fig. 24). The treatment used to be excision of a V-shaped portion of the fore part of the tongue, which protruded, and this, though attended with some risk, generally answered well enough ; but it could seldom be done in young children, and when done later, the deformity of the jaw was irremediable. More recently it has been found that methodical bandaging of the protruded part, if combined with the internal use of iodide of potash, is sufficient gradually to diminish the swelling. The bandaging of this unruly organ might seem difficult, but it can be done either with cotton bandage or strips of adhesive strapping, which, however, require to be renewed frequently, and the compression is more easily managed and more effectual than I could have at first believed. I certainly would not now have recourse to excision until I had given this method a fair trial.

ULCERATIONS OF THE TONGUE are very common. In a great many cases they look more formidable than they really are ; in many cases they are dependent on irritation of the gastro-intestinal mucous membrane, and in all cases their appearance is influenced by the condition of the digestive organs. In other cases, the ulceration has been originally caused, and its unhealthy condition kept up, by the local irritation produced by some sharp corner of a tooth, or the fastening of some false teeth, the adjustment of which has become disarranged. In the class of cases I have just mentioned, the treatment is obvious—removal of the exciting cause by filing down or removal of the offending tooth, the proper adjustment of false teeth, or leaving them out for a time till the ulcer heals, and the use of some mild wash, composed of borax, or chlorate of potash, combined with honey or glycerine and water. In more obstinate cases, the best local application is the sulphate of copper. In cases where there is a constitutional taint, such as syphilis, the appropriate constitutional remedies must of course be used ; whilst in those cases where the ulcers evidently arise from, or are kept up by derangement

of the digestive function, the treatment is directed to improve that.

Unfortunately an ulcer of a cancerous nature, EPITHELIOMA OF THE TONGUE (Fig. 25), is too frequently met with, and presents

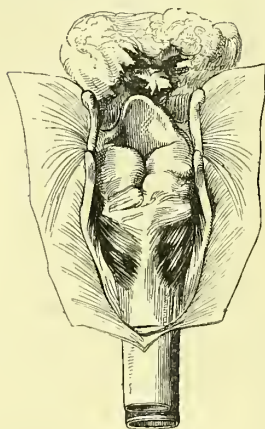


Fig. 25.

the usual history and character of that form of cancer. The only remedy for this is early removal by operation, and even this is not very hopeful. In speaking of epithelial cancer, I said that it was really no more localised than any other form of cancer, and that in patients suffering from this disease, we often find the cancer recurring, not in the part from which it has been removed, but in other parts of the body. I have removed it from the lip, and the disease has returned in the testicle, scrotum,

and elsewhere: it is simply a manifestation of the cancerous diathesis. The disease is quite as much constitutional as any other form of cancer, and the structure affected merely modifies its local character.

The expediency of removing the tongue for cancer will depend on the extent of the disease. If in every case of cancer of the tongue, the disease were localised, the operation of removing the whole tongue might be warranted; but if, as I believe, it is not localised, then, I think, we must deal with the disease according to its extent and position. If the disease occupies a small portion of the tongue only, the best method is simply to remove it by an incision wide of the part, arresting the bleeding by torsion, or by applying the cautery to the surface. Where the tip or upper portion of the tongue is affected, a V-shaped portion may be removed, and the parts brought together after the bleeding is arrested. This enables the patient to retain the power of speech. Or we may strangulate the anterior half of the tongue, and cut off the cancerous mass in front of the ligatures, or the

operation may be effected by the *éraseur*. The removal of half of the tongue, or even of the whole tongue, may be effected in various ways. It has been done in Italy more than once by means of an incision below the jaw—the tongue and os hyoides being drawn out under the jaw-bone, and as much of the tongue then removed as necessary, the vessels being ligatured where they enter the organ. The late Mr. Syme performed the operation by making an incision through the soft parts in the mesial line, from the margin of the lower lip to the body of the hyoid bone, and then dividing the inferior maxillary bone, the two halves of which were drawn aside, so as to expose fully the cavity of the mouth and sublingual region. There is always a very great risk superadded in cutting the bone, and if we can manage the operation any other way, we should do so. In some cases lately, it has been done without any section of bone, by simply drawing the tongue forwards in the mouth. In other cases an incision has been made through the cheek at the angle of the mouth, so as to get a larger opening, and then a knife or *éraseur* passed in and the tongue removed.

Cases of epithelial cancer of the tongue are not very encouraging, for the operation of excision of the tongue is very generally fatal, and even when the patient escapes from the immediate danger, the recurrence of the disease is very rapid. Still, from the intense suffering of the patient, the operation may be had recourse to for the great, though temporary, relief which it affords. The diagnosis of these cases is, however, very important. In a case I saw lately, the patient was suffering from what seemed to be very marked malignant disease, but which turned out to be merely a chronic syphilitic affection of the tongue. The patient recovered after tracheotomy had been performed. There was no malignant disease present, but simply a chronic thickening and ulceration of the back part of the tongue.

We occasionally meet with tumours developed in the covering of the hard palate, or in the substance of the soft palate. These growths are generally of a benign character, and of fibrous structure; sometimes, though rarely, fatty, but firmer than the

ordinary adipose tumour. In many cases these palatine growths are of considerable size, and pendulous ; at other times we find the tumour imbedded in the palate, but loosely connected. In either case their removal is obviously the proceeding to be adopted, and this is easily accomplished. In the case of pendulous tumours, the root of the pedicle should be included in an elliptical incision, to divide the substance of the palate around it, and then either twisted or cut out, so as to leave no portion of the pedicle. Those tumours which are imbedded in the substance of the palate are removed by a longitudinal incision through the palate directly upon the growth, which is then fixed with a sharp hook, and readily turned out with the handle of the scalpel. In the cases on which I have operated I have never required to tie any blood-vessel.

LECTURE C.

Diseases of the Jaws—Abscess of the Antrum of Highmore : its Symptoms and Treatment—Abscess in Lower Jaw—Epulis—Cystic Tumours of Upper and Lower Jaws—Simple and Malignant Tumours of the Jaws—Excision of the Upper Jaw—Various Methods of performing the Operation—Excision of the Lower Jaw—Partial Resections—Disarticulation of the Lower Jaw—Excision of the Central Portion of the Lower Jaw.

THE upper and lower jaws are frequently the seat of diseased conditions which require operative procedure for their cure. The forms of disease most frequently met with in the maxillary bones or their coverings are—abscess of the antrum of Highmore in the upper jaw, or abscess in the body of the lower jawbone, with expansion of its structure ; epulis, cystic and fibrous tumours, osteo-sarcoma and osteoma amongst the simple growths ; and the different forms of medullary tumours, from those of fibroid or fibro-plastic structure to those of true cerebriform consistence, amongst the malignant growths. Tumours of the latter class are, unfortunately, much more common than the simple.

ABSCCESS OF THE ANTRUM is a very common affection, and, in general, is easily diagnosed, although under some circumstances it may simulate more serious disease of the upper jaw. The abscess is usually the result of inflammation of the lining membrane of the cavity, caused by cold or the irritation from decayed teeth or stumps, and not unfrequently from the pivoting of artificial teeth leading to irritation. The symptoms are intense pain and tension felt in the part, the pain very similar to tooth-ache. There is considerable fever, then acute œdema of the cheek supervenes, and, on examining from the mouth, the mucous membrane is seen to be tense, and the anterior wall of the antrum is felt to bulge forwards, and has a peculiar elastic feeling to the touch.

If the disease has occurred slowly, more in the form of chronic than acute abscess, the symptoms are modified in their intensity, and after a time pus and mucopurulent matter escape through the opening from the antrum into the middle meatus of the nose, when the patient is recumbent, and the matter is felt passing downwards. The early or palliative treatment is to remove all obvious sources of irritation, and to allay pain by opiate fomentations to the cheek. So soon as we are satisfied that there is pus in the antrum, we should extract the tooth corresponding to the cavity, and perforate the alveolus into the antrum. This, however, is rarely sufficient. We must make an opening through the anterior wall of the cavity with a stout bistoury, and, if necessary, remove an oval portion of the parietes of the antrum. Thus a free escape of pus is permitted, and we can thereafter syringe out the cavity twice a day, and inject weak stimulating lotions to promote the cure.

IN ABSCESS IN THE LOWER JAW, owing to the increased thickness of the bone corresponding to the purulent collection, diagnosis is often very difficult, and we must trust chiefly to the history of the case in connection with the appearance of the affected jaw. In some instances we may be obliged to make an exploratory perforation to make quite sure. In many cases the oozing of matter by the side of a tooth will guide us to the right conclusion; and if there be any decayed or loose teeth, it is advisable to remove them, and then the escape of matter will at once satisfy us of the presence of an abscess. In some instances the osseous walls of the bone expand without thickening, and become like parchment. Then the diagnosis is easy, and the treatment equally so. An opening is made in the expanded bone with a bistoury, and a portion cut out to permit free vent for the pus. In those cases where the bone is thickened, we require to use a small trepan to perforate the bone. After evacuating the pus, the same treatment is adopted as in the case of abscess in the upper jaw.

EPULIS is a fibrous tumour arising from the gum-texture, and resembling it in structure, but prominent and irregular on the surface. It is a perfectly simple growth, and generally arises in connection with irritation from decayed teeth and an unhealthy state of the alveolar process. In excising the tumour, it is always advisable to remove the underlying portion of the alveolus with the cutting pliers, to ensure complete removal of the growth, and any likely source of irritation. In some cases, when the tumour is merely cut off from the gum, it returns. This is not due to any malignant tendency, but only because the tumour takes its origin from the periosteal covering of the alveolar process, and has not been thoroughly removed; hence the propriety of making sure by removing the portion of the process corresponding to the tumour.

CYSTIC TUMOURS OF THE JAWS are very common. In the upper jaw, the cyst is generally in the antrum, and in some cases of chronic abscess of the antrum, the general appearances and symptoms are not unlike. Indeed, in many cases, suppuration in such cysts often occurs in consequence of irritation. In one case of a young woman, both sides of whose upper jaw were affected, I found that the cavity on the one side contained the ordinary glairy cystic fluid, whilst on the other side the antrum was distended by thin purulent matter. The cystic tumour is distinguished from the acute abscess by the absence of febrile symptoms, and the acute œdema of the cheek, and also by the slow and regular increase of the swelling.

The *Treatment* is very similar to that of abscess of the antrum. We open the anterior wall of the cavity, and remove a portion of it, sufficiently large to enable us to evacuate the contents of the cyst, and apply tincture of iodine or solution of nitrate of silver to the interior of the cyst, to destroy its secreting structure. The osseous walls are in general so thin, almost resembling parchment, that there is no difficulty in opening them with a common bistoury and removing an oval portion with curved scissors.

CYSTIC TUMOUR OF THE LOWER JAW is also a not uncommon affection. In some instances, it is simple cystic expansion of the bone, and is usually situated near the anterior surface. In such cases, all that is required is to open it up, and with a small pair of bone-pliers, cut away as much as possible of the projecting anterior wall of the cyst, and then apply nitrate of silver or chloride of zinc to destroy the remaining cystic surface. When this is done, the cavity granulates, the thickening around becomes absorbed, and the cure is completed. But if the growth returns or fungoid projections take place, or if the cystic tumour be large and multilocular, then the safest practice is to excise the portion of the jaw in which the growth is situated, wide of the disease.

The other forms of tumour to which the jaws are chiefly subject are—osteoma, osteo-sarcoma, fibrous tumours, and the different forms of malignant growths, and present the usual characters and history of such tumours. When speaking of malignant tumours of bone I referred specially to the tumours of the upper and lower jaws, in regard to their peculiarities, so that I need not dwell on them again. In all the simple tumours there can be no question of the propriety of their early and complete removal, before they involve a large amount of the bone, or over-distend the skin, or become adherent to the soft parts from inflammatory action. At the same time, the bulk of the tumour, supposing it to be simple, is no objection to its removal, nor does it much increase the difficulties of the operation, unless the soft parts have ulcerated from pressure, or become adherent. In the upper jaw especially, a large firm tumour, such as that represented in the accompanying woodcut (Fig. 26), is often removed with greater facility than a small one, from the amount of leverage which it affords, and because the osseous connections are thinned by the pressure of the growth. In large simple tumours of the upper jaw, in which the skin is tense, thin, and adherent over the tumour, by carefully planning our incisions, it is surprising how little difficulty arises in bringing the parts into contact without overstretching them ; whilst, even in extreme cases, plastic

operations enable us to fill up the gap. In one case of malignant tumour of the upper jaw, which I alluded to when lecturing on



Fig. 26.

malignant tumours of bone, and in which all the soft textures of the cheek required to be removed with the growth, I dissected a large flap to form a new cheek, and the patient made a good recovery at the time, although she died about two years afterwards from recurrence of the disease in the superior maxilla of the opposite side. The appearance of the patient immediately before and after the operation, is shown in Plate xlv. Figs. 1 and 2.

I shall now proceed to the operations required for the removal of such tumours.

In the lower jaw, even malignant growths, being more circumscribed anatomically, if they arise in the interior of the inferior maxillary bone, may be removed by operation with better chance of success than in the upper jaw. For in the case of tumours arising in the antrum, we have not the same limitation. Very generally in such cases the disease, before it shows itself towards the face, has affected the base of the cranium. Such soft growths, indeed, often arise in the ethmoid cells, and

then we cannot extirpate the whole of the disease. In tumours of a more fibro-plastic character, and less rapid growth, however, we may give the patient the benefit of the operation, though the disease may possibly recur. A good practical rule in regard to tumours of the upper jaw is, not to interfere when there is projection of the eyelids and eyeballs with eversion of the eye, the latter symptom especially, shows that the tumour has commenced in the ethmoid bone, and is bulging outwards the contents of the orbit.

In **EXCISION OF THE UPPER JAW** the lines of incision will depend entirely on the size of the tumour. Sometimes an incision made in the middle line of the upper lip will enable us to lift up the upper lip and cheek, and remove the tumour ; for we must keep in mind that the mobility of the soft parts forming the cheek, and the opening of the nostril, give us great space when the lip is divided, and enable us to remove a tumour of some bulk, affecting only the body or lower part of the superior maxillary bone. If the malar bone or floor of the orbit be involved in the disease, or require to be removed, then we enlarge the incision upwards along the side of the nose towards the inner canthus, and are thus enabled to dissect back a flap sufficient to expose the parts beyond the tumour on each side. The incisor teeth should always be extracted before beginning the operation. To divide the osseous connections, we require, after division of the soft palate, to introduce a narrow saw into the nostril, and saw very deeply in front through the bone, and then with a pair of bone-pliers we cut through the nasal process of the maxilla, and then saw through the bone at its outer attachment with the malar. In all cases we divide the covering of the hard palate longitudinally, and the soft palate transversely out towards the tuberosity of the jaw.

It is very rarely, however, that the superior maxilla alone is affected, and in cases such as that represented in Plate xlv. Fig. 3, we require to dissect a larger flap by a rather different form of incision. We first make the same incisions as last

4-

Fig 2



Fig 1



Fig 3



described, and then cut outwards along the lower margin of the orbit. The large flap thus marked out, when dissected off the bone, lays bare the entire surface of the upper jaw and malar bone, and enables us to remove a tumour of any size. We must be very careful in clearing the floor of the orbit ; a thin copper spatula should be used to guard the parts within that cavity. The malar bone is generally very dense, and requires a deep section with the saw. It is sometimes very difficult in such cases to get the soft palate divided properly, owing to the tumour being close to the teeth, and pressing down towards the tongue. When we remove the whole of the upper jaw in this way, the wound is entirely in front of the soft palate. When all the bleeding has been arrested some slips of lint are introduced into the large gap left by the removal of the jaw to support the cheek-flap, which is then adjusted. These slips of lint are removed in a few days through the opening in the palate. The surfaces generally heal by the first intention, and very little deformity is left. (See Plate xlv. Fig. 2.)

Excision of the whole upper jaw and malar bone, for these large tumours, may also be effected by means of a single oblique incision through the cheek. The incision is commenced above the zygomatic process of malar bone, and carried obliquely downwards and forwards to the angle of the mouth. The soft tissues of the cheek, lip, and ala of the nose are then detached, and drawn upwards and inwards, so as to expose the body of the tumour, the nostril, and ascending or nasal process of the maxilla. The attachments of the temporal muscle in the zygomatic fossa are next separated. The soft palate and the osseous connections of the tumour are then divided, and the jaw removed as in the operations already described.

The method of operating for EXCISION OF THE LOWER JAW will depend on the nature and extent of the disease. In simple growths, all that is required is to remove the tumour, together with a portion of sound bone on either side of it, for there is no tendency to reproduction in these cases. For example, if a firm

tumour of a non-malignant character exists in the lower jaw, we do not require to remove the angle of the jaw or the chin, but merely to go a little beyond the tumour on each

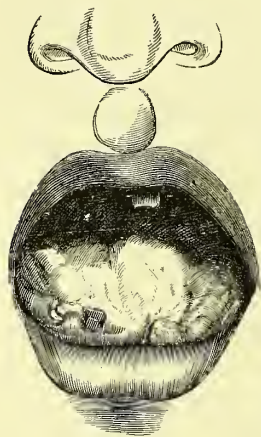


Fig. 27.

side ; and in such cases as that represented in Fig. 27, affecting the centre of the lower jaw, we do not require to remove the lateral portions of the bone, when we merely require to remove the tumours along with a small portion of the jaw on either side of it, and we may do this and leave very little deformity. In a case I operated on lately for disease of the bone, the diseased portion included nearly the two-thirds of the horizontal portion of the jaw, and yet it was removed with hardly any external incision. I merely made a small incision

on either side, to allow me to introduce a small saw to cut through the bone. The lip was then turned down without cutting it, and the mucous membrane and soft parts separated from the bone. The precaution was taken to fix the point of the tongue, which might retract and turn upon itself, and suffocate the patient. In any tumour not involving the angle of the jaw, this plan may be followed out, without making any large external incision, and merely leaving a small opening for the escape of the discharges from the wound, if necessary. In other cases, where we have a tumour of the lower jaw occupying nearly the whole of one side of the bone, if the tumour be at all of a doubtful character, the whole lateral portions of the jaw ought to be removed by disarticulation, because if we leave a portion, such as the angle of the jaw, then if the disease should return, and we subsequently require to disarticulate, the difficulty of doing so becomes very great from the want of leverage, and in some cases the use of forceps to grasp the bone will not answer, as the bone is soft, and gives way under their pressure. Then we require to dissect the part out, which is both difficult and dangerous. Hence, I think, the best plan in all

such cases is at once to remove by disarticulation the whole lateral portion of the jaw at or within a short distance of the symphysis.

The operation of **DISARTICULATION OF THE LOWER JAW** is performed in various ways. At first it used to be done by means of an incision made from the angle of the mouth running upwards towards the zygoma, and another from the lip obliquely downwards to below the base of the jaw. The large flap so formed was dissected back, the bone then sawn through near the symphysis, the temporal muscle divided, and the bone exposed at its articulation, and readily removed. But this method left two very ugly scars across the face, and the mouth was divided at two points. Another objection was that there was no small risk of dividing the parotid duct, and it makes a great difference, whether we divide the main duct or merely branches of it. In cases where the substance of the parotid gland is cut, we have a little saliva oozing out for a short time, but this disappears gradually; but when the duct is partially wounded, we find generally that the saliva makes its way out by the wound, and so keeps it open. The principal objection, however, to this method was the great deformity left.

The method generally adopted now is to begin the incision above the articulation, and in front of the temporal artery, carrying it deeply down to the bone along the ascending ramus of the jaw, and carrying it forwards under the horizontal ramus till we come to the point where the section of the bone is to be made, and then curve it gently up towards, but without dividing, the lip.

In making this incision, the facial artery should be secured before being divided, or it may be commanded by acupressure applied to the vessel below the jaw. The large flap marked out is dissected rapidly upwards and inwards, and the bone exposed. A narrow bistoury is passed towards the inner side of the jaw, so as to clear the bone, which is then sawn through to a certain extent, and divided with the bone-pliers. By using the divided ramus as a lever, the coronoid process is brought well down, to enable us to feel it, and so to divide freely the attach-

ments of the temporal muscle. Then the jaw is turned outwards, and readily disarticulated. There is not much risk of wounding the maxillary artery if we open the joint in front, and keep the edge of the knife close to the bone.

This is the plan I usually adopt, but as regards its results, it seems questionable whether the two scars caused by the old method, or the effects of this plan, leave the worst kind of deformity. There is no scar left in this method, but there is often complete paralysis of the face, from the trunk of the portio dura being divided in the operation, which it was not in the old method. The only way to remedy this evil is to make the incision along the base, and merely curve it up slightly over the angle of the jaw in raising the flap, and then dissect very close to the bone, so as to avoid the trunk of the portio dura. This renders the disarticulation more difficult, but then there is no loss of nervous power or expression, there is less inequality in the two sides of the face, and no twisting of the features. In cases where the tumour is very large, however, we can scarcely do this, for then we require to make a very free incision to enable us to disarticulate easily and safely. After securing the bleeding vessels, the line of incision is accurately closed by points of silver suture. The patient should be desired to lie on the opposite side, to prevent the saliva or discharge resting in contact with the wound.

Some details require to be specially attended to. In making our first incisions, the facial artery should be ligatured if possible before being divided, for it bleeds very profusely, and may give a great deal of trouble. Of late, in excising either the lower or upper jaw, I have used acupressure on the facial artery below the jaw to command the bleeding from it, both during and after the operation, with great advantage. The teeth corresponding to the point of section of the jaw should be extracted before the operation. The flap must be dissected up very rapidly, and the edge of the knife kept directed towards and close to the bone. The bone is cleared a little external to the symphysis, and sawn through there. We should not attempt to divide the bone with cutting pliers too soon. The saw should

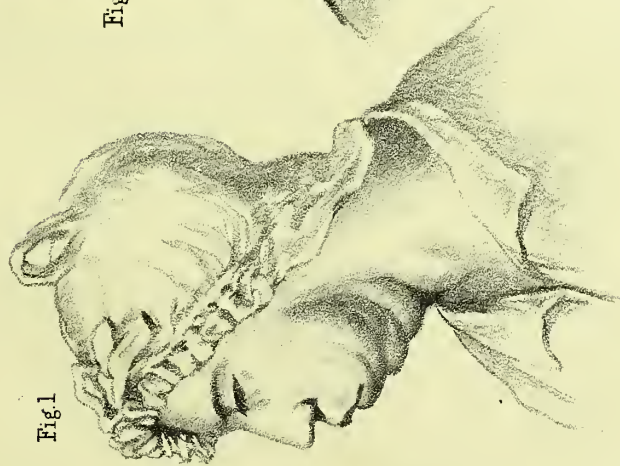


Fig. 1



Fig. 2



Fig. 3

be principally used, and made to act chiefly on the base of the jaw, which is the densest part of the bone, then the division of the bone completed by the bone-pliers. The key of the operation in disarticulating the jaw, is free and early division of the temporal muscle at the point of attachment to the coronoid process of the jaw, and then forcing the jaw outwards. In general, when after section of the horizontal ramus we depress the jaw, the coronoid process can be readily felt, and by cutting upon and around its point, the narrowest attachment of the muscle is divided. In one case, in which I operated for osteo-sarcoma, the coronoid process was so altered in structure as not to be distinguishable by the finger, so I cut through all the textures with the bistoury, but finding that the point of the process still remained in the muscle left, I drew it down with a vulsellum, and removed it.

The method of excising the central portion of the lower jaw will depend on the nature and extent of the disease on account of which the operation is undertaken. I have alluded to a case in which I effected removal of the symphysis, and a large portion of the base of the lower jaw, with scarcely any external incision—merely two small incisions to enable me to introduce the narrow saw to divide the bone on each side, and then separated the detached portion from within the mouth. But when there is a large or projecting growth, such as that shown in Fig. 28, we must proceed differently. In some cases, by means of a free incision along the inferior margin of the base of the jaw, with a little dissection we clear the lower lip from the bone, and draw it upwards, next clear the bone from its attachments on its inner surface, and saw it through on each side wide of the tumour, and so remove it. In other cases we may require to make an incision through the lip in the central line, and another at a right angle to it along the base of the jaw, reflect the flaps, and saw through the bone at each side, detach the soft parts from the inside of the jaw, and thus remove the diseased part. In some respects, so far as the manual procedure is concerned, the excision of the central portion of the jaw may seem,

and indeed is, a comparatively easy operation. But, however performed, it is a very dangerous one, and the danger is pecu-



Fig. 28.

liar ; it consists of the risk of suffocation from retraction of the os hyoides and tongue, when the attachments of the mylo-hyoid, genio-hyoid, and genio-hyoglossi muscles are divided from the bone. To avoid the immediate risk during the operation, we fix the tongue by means of a strong ligature passed through it near its tip, and held by an assistant. In most cases this suffices, as the tendency to retraction generally soon passes off. We cannot, however, trust to this, as fatal cases have occurred at a later period, and hence in all cases the ligature through the

tongue should be fastened to the inside of the lip or to a silver wire stretched between the teeth on each side of the section. In a case which I recorded in 1842, where I required to disarticulate the lower jaw of a woman, in whom the opposite side of the jaw had been previously removed, I determined to leave the symphysis, to obviate the risk I have just mentioned ; and, supported as it was by the old cicatrix of the soft parts, it effectually prevented it, and permitted a greater use of the incisor teeth than I had anticipated. (See Clinical Cases.)

After operations for removal of portions of the lower jaw, the use of the simple apparatus first suggested to Mr. Liston by the late Mr. Nasmyth of this city will be found of great service in preventing twisting of the remaining parts of the jaw. The apparatus consists of a case of caps fitted to the teeth of the upper and under jaw of the sound side. This is prepared before the operation, and then fitted on so as to retain the sound portion in position, and prevent twisting of the face. This apparatus is also useful in some cases of fracture of the jaw.

